A STUDY

OF THE

DEGENERACY OF THE JAWS OF THE HUMAN RACE.

By EUGENE S. TALBOT, M.D., D.D.S.
CHICAGO, ILL.

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BY EUGENE S. TALBOT, M.D., D.D.S.,

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A STUDY OF THE DEGENERACY OF THE JAWS OF THE HUMAN RACE.

By EUGENE S. TALBOT, M.D., D.D.S., Chicago, Ill.

In the scientific study of the evolution of the human race, man must be studied as an animal and the subject must be considered from two standpoints, because two structures are involved: first, the nervous system, and second, the osseous system. In the evolution of man great changes take place, and these changes are not unlike the modeling of a human being in clay. The sculptor, after he has fashioned his subject in a general way, adds small pieces of clay at one place and removes them from other places. Little by little these changes are made, until the clay begins to take on shapeliness and finally becomes a thing of beauty. So it is with the development of man. The orang and the chimpanzee represent the clay fashioned relatively less perfect. The changes which then take place in the development of man are as great, if not greater, than those which take place in the development of a clay model. Having the framework to build upon, the brain commences to develop, and in its development the osseous system must be reduced at one point and built out at another. The animal which possessed only instinct now begins to reason and think for himself. Then he depended upon nature for his food, for his subsistence; now he commences to collect material and to prepare his food by cooking. The continual development of the nervous system is accomplished at the expense of the osseous system. Thompson says,* "The structure of the face arose from its parts having been created for the accommodation of the speech and sense-organs, and upon these foundations the facial features were constructed, and facial expression became possible. The invertebrate animals have the special sense-organs scattered over the entire body, so that there

* Dental Cosmos, 1890, pp. 633, 683.

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is really no face, strictly so called, until we reach the vertebrates, where the face and special senses are located within a limited area upon the front of the head."

The animal depends upon its physical strength for its food and for protection. The bony framework is very strong. The bones are large, long, and the prominences upon their surfaces for the attachment of muscles are very marked, thus indicating that the muscles are large and strong. As we ascend the scale to man, we find that the bones are smaller in diameter, and shorter, showing that the muscles are not so large and strong. Great changes take place in the jaws and teeth. They become smaller in size, the teeth change their shape, because man now is no longer required to procure his food with his teeth or to protect himself by his jaws. The brain is continually enlarging and changing its shape, and the bones of the head, especially the parietal and frontal, expand forward, laterally, and upward. The temporal muscle, zygomatic arch, and jaws decrease in size and are not so prominent. If we compare the jaws of the orang and chimpanzee with that of a negro, we observe a wonderful difference as regards size, shape, and character of the teeth. If we will now compare the negro jaws with those of our working-classes, and these latter with the jaws of young people of the well-to-do class, who are not required to work physically, we shall observe almost as great a change as we noticed in the case of the orang and the negro. These changes are the result of the law of compensation. The tendency of the human race is to develop in an intellectual line, and if the race seeks a high education and brain-development, without a corresponding physical training, the result is a fully developed cerebrum and a weak physical structure. Our food is now prepared in such a manner that mastication is almost unnecessary, and arrest of development of the jaws and decay of the teeth must follow as a result. Comparing the shape of the face, head, and general make-up of the present people with those of our ancestors, there can be no question that the human race is improving in grace, beauty, and intellect. The changes which occur in the general outline of the head and jaws in a few generations, are excellently illustrated in the following portraits of a noted family in this country. Four generations are here shown, in the order in which they lived. The cuts are drawn from daguerreotypes and photographs, and of course are useful only in giving the general outlines of the shapes of the heads. Unfortunately, the hair upon the faces depicted in the last two illustrations forbids any comparison being made so far as the jaws are concerned. There is, however, such a contrast in the shapes of the heads that those who are familiar with craniology can readily trace the changes which would naturally take place in the shapes of the jaws.

Fig. 1 represents a man born in Connecticut in 1761 ; died in 1826. This picture represents a brachycephalic head with massive jaws, prominent lips, especially the upper. The nose is long, and the eyes are set close together ; the forehead very high and straight.

Quite a change is noticeable in the second generation, depicted in Fig. 2. The face is not so long, the lateral diameter of the head is larger, the forehead more prominent, and the eyes are a little farther apart. The nose is about the same length, and while there is a general resemblance about the mouth and chin, the distance from the

front of the chin to the tip of the nose is not quite so long. The change seems to be in the shortening of the chin.

FIG. 1.

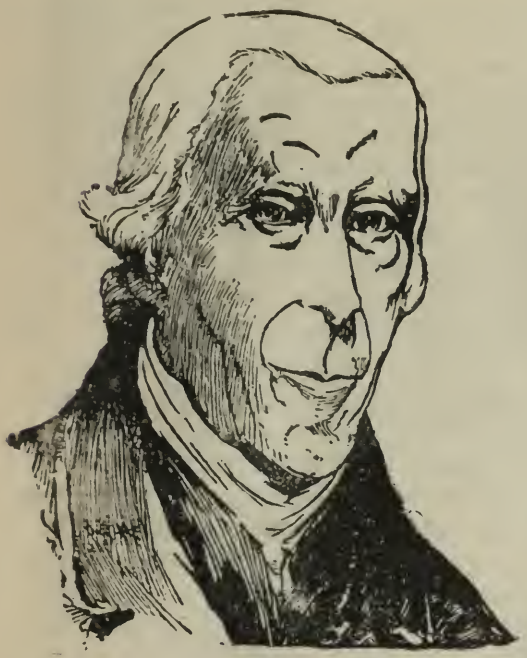

FIG. 2.

Fig. 3 shows still further change. The forehead is broader and less retreating than either. There is perceptibly less prognathism. There is less prominence in the supraorbital region.

FIG. 3.

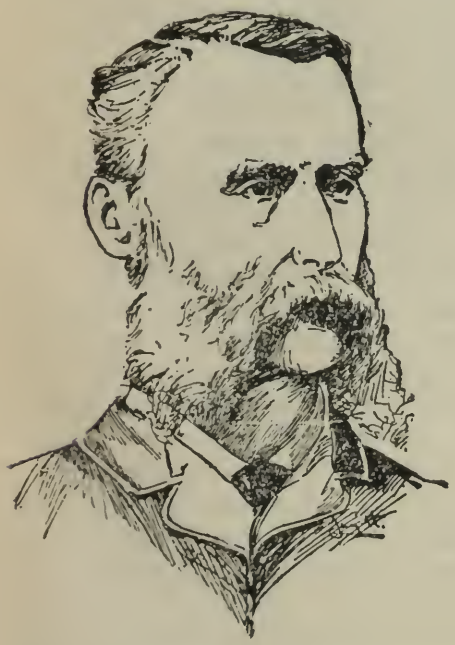

FIG. 4.

Fig. 4 shows a head just the opposite of Fig. 1. This is a dolichocephalic head. The head is nearly round; forehead full; eyes set in the head to correspond with the width of the head; nose

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broad ; upper lip short, and lower jaw much broader than in Fig. 1. The lower jaw is evidently much shorter in a perpendicular line. These changes are due to a protruding forehead, receding chin, and delicate features.

As we shall see later on, children born of neurotic parents are apt to inherit brilliant minds and very weak constitutions. They are very bright scholars, always standing at the heads of their classes. Such children are very susceptible to disease, and it not infrequently happens that when disease comes, death is the result. If they grow up, they frequently become geniuses or insane, drunkards, criminals, or egotists. There is a reason for this change of structure, in the building up of the nervous system and arrest of development of the osseous system. The food taken into the stomach contains a large amount of the phosphates of calcium, sodium, etc. This material (if assimilated) goes to form brain, bone-substance, and teeth. If the brain becomes more active than the osseous system, more blood will go to the brain, and therefore will deposit the phosphates for the purpose of repair, at the expense of the osseous system. If the jaws then are not exercised, blood will not flow to them, and arrest of development and atrophy are the result. This statement is a matter of fact, observed by every one of experience. Let a child visit his dentist and have his teeth put in order ; he then goes to school or college ; on his return to the dentist at the end of the year, he will find in many cases that the teeth have decayed around the fillings, and in new places. This occurs to a greater extent at this time than at any other during the growth of the individual. This shows conclusively that during the past year the brain has been more active than the physical part of the person. This fact is also nicely illustrated in a case now under my care. Miss H., thirteen years of age, of very slight build, bones very small for her age, is of very nervous temperament ; cries without the slightest provocation, and has incontinence of urine. Is constantly doing things at home that she ought not to do, for which she is being continually punished by her parents, who are not aware that she is not responsible for her acts. She goes to school, is very bright, and learns her lessons apparently without much effort. She eats and sleeps well, is very fond of meat, which she eats largely, and does not like milk. She is under treatment by her family physician. She was sent to me because of the peculiar condition of her mouth and teeth, which revealed to me the whole cause of her trouble, and to my mind she is one of the most interesting cases I have ever seen, nicely illustrating the point under discussion. All the teeth were yellow, and when an instrument was passed over the outer surface, the enamel (which should be as hard and smooth as glass) could be easily scraped off like horn. All the teeth were completely covered with tartar. When the instrument was applied for the purpose of the removal of the tartar, the little girl would wring her hands and cry, seeming to be in great agony. The teeth had spells of aching ; sometimes the aching would be in one tooth on one side, and sometimes in another tooth upon the other side. This pain was most intense, neuralgic in character, lasting from ten minutes to one hour. There are no cavities in the teeth. Although the child is taking plenty of nourishment, it will be observed that the phosphates and carbonates are not assimilated, as indicated by the nervous and

osseous systems, and also by the teeth. The large amount of tartar upon her teeth is positive proof that there is lack of assimilation. Tartar should not accumulate upon the teeth before the person has attained his growth, say at the twenty-sixth year, and the fact that it is deposited in such large quantities, and at this early age, shows that the phosphates are excreted by the salivary glands. The tartar being alkaline, prevents the decay of the teeth. Thus we have seen that the phosphates are necessary for the development of the bone as well as of the brain, and that the excessive development of one structure must necessarily be accomplished at the expense of the other.

In the study of evolution, no part of the body has received so much attention as that of the maxillæ and cranium. There are two reasons for this : one is that greater changes are noticeable in these structures ; second, the close proximity of the maxillæ to the cranium, and to each other, permits them to be easily studied, and changes are more easily noticed.

Vogt says,* "The skull is chiefly important from its investing the brain so closely that its chief features are impressed on the inner surface of the cranium." Although the jaws have to a certain extent been taken into consideration in the study of evolution, the cranium has received the greater attention of the two osseous structures. The changes which have taken place in the jaws have only been studied by scientists in a general way. I shall therefore, as a specialist, study this subject in its details. The quotations as far as possible will also be taken from articles written by specialists. By so doing we shall obtain the facts as they appear to those who are constantly operating upon the mouth, jaws, and the teeth.

Following a law of evolution pointed out by Ray Lankester,† certain conditions become, under changed conditions, the fittest ; these survive, and evolve along the lines of degeneracy. This principle has produced, from a vertebrate type, the tunicata molluscoida, and the same element, influenced by sexual selection, has produced the degenerate parasitic male barnacle. These, however, are extreme instances. As a rule, individual structures, for the benefit of the animal as a whole, become degenerate in type, and thus enable the organism, degenerate in certain particulars, to survive as a whole, as the fittest.

Dr. Hammond has made the remark that the coming man will be hairless and toothless. But it is apparent to everyone that the people of the present age are not only losing their hair more rapidly, and at an earlier age, but the teeth also are subject to an earlier decay and degeneracy, and the eyesight and hearing are deteriorating. In my work on "Irregularities of the Teeth," and in papers read before medical and dental societies for the past eight or ten years, I have alluded to the fact that the jaws of man are undergoing a change in shape, and that the maxillary bones are diminishing in size. In my investigations for the causes of irregularities of the teeth, I have frequently observed facts to prove this assertion, but not until now have I been able to bring sufficient proof to warrant me in presenting my views to the public.

That irregularities of the teeth and jaws are becoming more numerous

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* Lectures on Man.

† "Degeneracy. A Study in Evolution." Humboldt Library.

as each generation is ushered into the world, every physician and dentist is well aware. That there is a cause for irregularities all must admit. Irregularities of the jaws and teeth were never observed among the ancient races, nor are they found among the pure races of to-day. There are very few among the clannish European, African, and Asiatic at the present time, but irregularities of jaws and teeth are very common among the Americans and are very numerous among the nobility of European countries. The features of the early races and the features of the European, the African, and the Asiatic differ not only from those of the people of this country and from one another, but also from former generations of the same race, as it is a well-known fact that marked changes take place in the faces and expressions of the same people in one or two generations. The African of this country is a well-marked illustration of this kind.

One condition aiding if not producing this degeneracy is the small size of the jaw. The truth of this statement is easily verified by either observation or reading. All anthropologists unite in affirming that the jaw of animals is larger in proportion to the cranium than that of man, and the jaw of the savage races is larger than that of civilized races. "One is struck by the great backward elongation of the jaws, etc., in apes. The teeth and jaws are much larger in all their directions than in man. But the want of space in the jaw in man is only too conspicuous ; the contraction acts as if expecting the absence of the wisdom-tooth, and this having failed to occur, is, in consequence, a premature and anticipatory operation of the laws of economy of growth. The compression which the shrinking of the contracted bone exercises upon the wisdom-tooth in all stages of its existence must be very great, and possesses as potent influence in hastening its suppression as its own innate, growing defectiveness. As Dr. D. C. Hawxhurst has said, "The maxillæ of civilized races are smaller than those of savage races, which has come about through slow changes that have taken place in the environments, through the influence of which there has been a hereditary transmission of a small element of decrease to each successive descendant. The teeth have felt the influence of this changed environment fully as much as the jaws, but not in the same way. They have dwindled less than the maxillæ, and are therefore too large for the jaws and suffer from unnatural pressure. The wisdom-tooth has suffered from this disparity between the size of the teeth and jaws more than the other teeth. It is slowly becoming rudimentary. The inability of the hard parts of the teeth to correspond in size to their lessened function, or, in other words, to keep pace in retrograde evolution with the jaws and soft parts, has resulted in weakening the structure of these organs."* Mr. West has presented nearly the same views. That the increasing contraction of the jaw in the higher races is contributing largely toward the suppression of the wisdom-tooth, there is no doubt.† "Among the causes of pressure of the teeth, I would suggest the rapid intellectual development of the race" (*i.e.*, the civilized portions) causing a retrograde evolution in regard to the size of the jaws. The jaws might be shortened after the lapse of many generations by the extraction

* Dental Cosmos, vol. xix, p. 125.
† Proc. Odont. Society of Great Britain.

of teeth, in-and-in breeding, etc. With increase in the capacity of the brain-case there seems to be a decrease in the size of the maxillæ. The substitution of food which requires but little exercise and power of the masticatory muscles will, in a long series of generations at least, diminish the size of the jaws. This evolution of food is now going on, with regard to the race, without regard to the intellectual development of the individual.* But the cause of the degeneracy of the wisdom-tooth and maxillæ is found in their disuse. This cause has been transmitted with increasing force to succeeding generations.

Professor Schaafhausen accounts for this difference between the races by the posterior dental portion of the jaws being always shortened in those that are civilized, and this shortening may, I presume, be safely attributed to civilized mankind habitually feeding on soft, cooked food, and thus using their jaws less. I am informed by Mr. Brace that it is becoming quite a common practice in the United States to remove some of the molar teeth of children, as the jaw does not grow large enough for the perfect development of the normal number.

Darwin says it is notorious that increased use in action strengthens muscles, etc., and that disuse, on the other hand, weakens them. The flow of blood is greatly increased toward any part which is performing work, and sinks again when the part is at rest, and consequently if the work is frequent the vessels increase in size and the part is better nourished.† Disuse at that period of life when an organ is chiefly used, —and this is generally during maturity,—together with inheritance at a corresponding period of life, seems to have been the chief agent in causing organs to become rudimentary. The term disuse does not relate merely to the lessened action of muscles, but it includes a diminished flow of blood to the part or organ, from being subject to fewer alternations of pressure, or from becoming in any way less habitually active.‡ As the early progenitors of man gradually acquired the habit of using stones, clubs, and other weapons for fighting, they would have used their jaws and teeth less and less. In this case the jaws, together with the teeth, would have become reduced in size. Continued disuse weakens and diminishes all parts of the organization. Rudimentary organs are generally variable, for, being useless, they are not regulated by natural selection, and are more or less liable to reversion. We do not know through what steps under nature rudimentary organs have passed in being reduced to their present condition, but we so incessantly see in species of the same group the finest gradations between an organ in a rudimentary and in a perfect state, that we are led to believe that the passage must have been extremely gradual. As soon as the part becomes useless, another principle, that of economy of growth, will come into play, as it would be an advantage to save the development of any useless part. Mr. Roman's view is, "All parts are somewhat variable, and fluctuate in size round an average point."§

With animals living a free life and occasionally exposed to severe competition, the reduction would be greater, as it would be an ad-

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* Dr. H. S. Chase, *Mo. Dental Journal.*

† "Variation of Plants and Animals under Domestication."

‡ "Descent of Man."

§ "Variation under Domestication."

vantage to them to have the development of every superfluous part saved. With highly-fed domestic animals, on the other hand, there seems to be no economy of growth, nor any tendency to the elimination of superfluous details.

Heredity, of course, must have some influence upon the development of the jaw and teeth, although not so strong an influence as other forces. Mr. Felix Weiss concludes that the existence of the wisdom-tooth depends more upon mind-development or civilization than upon physical development or strength. The period of its appearance is later and later in life as we ascend the scale of animals; thus, in apes it appears coincidentally with the canine; in man, about the twentieth year.

Mr. Darwin lays great stress upon correlated variation; that is, variation in homologous parts. Parts that are homologous tend to vary in the same manner, for such parts are identical in form and structure during an early period in embryonic development. From the correlation that exists, at least in some cases, between the development of the extremities and of the jaws, it is possible that in those classes which do not labor much with their hands or feet the jaws would be reduced in size from this cause. That they are generally smaller in refined and civilized men than in hard-working men or savages, is certain. But with savages, as Mr. Herbert Spencer has remarked, the greater use of the jaws in chewing coarse, uncooked food would act in a direct manner on the masticatory muscles and the bones to which they are attached.*

While the authorities quoted above are not so full as might be given, yet they are sufficient to show that there is no doubt that the jaws and teeth are degenerating. Actual measurement supports this theory. The results of the use and disuse of the jaws are demonstrated daily to the dentist. Thus we observe in the mouth of a young girl from fourteen to twenty years of age, who has been reared in a hotel in any large city, very slender and delicate jaws, a vault that is usually high, and a narrow alveolar process; the teeth are small, of a bluish color, crowded together, badly decayed, with a white chalky decay; the crowns are long and small, roots long and slender and lightly set in the alveolar process; the gums are puffy, anemic, and very thin. The body of the jaw is long, the rami are short, and the angle of the jaw is obtuse; the muscles are soft and flabby. This person lives upon liquid food, pie, cake, and very little meat; she has no appetite, takes no exercise, is out late at night, sleeps most of the day, and spends the remainder in riding and making calls. She is ill most of the time, and has no color. We then observe patients whose jaws, teeth, gums, and general health vary with their occupation and position in life, until we come to the extreme in the opposite direction. This individual may be represented by the inveterate tobacco-chewer, who keeps his jaws constantly in motion; this description will also answer for a description of an individual who speaks or sings much, or who exercises his jaws by masticating his food properly. The jaws are square, thick-set; the structure is dense and hard; the body and rami are of nearly equal length; the rami are at right angles with the body; the muscles are dense and hard;

* "Variation under Domestication."

the teeth are large, of a yellowish color ; the crowns short, roots well set in the jaw, decay is seldom found, but if present is of a black color, and arrested on account of density of tooth-structure due to the flow of blood and stimulation caused by mastication ; the alveolar process is thick, and the gum is dense and thick. This person has a good appetite, his stomach is in a healthy condition ; he has plenty of out-door exercise, and enjoys good health generally. These two descriptions serve as illustrations of typical cases of the two extremes, and can be easily seen in any dentist's office.

If anyone wishes further verification of these two cases, let him examine carefully the crania of the mound-builders or the ancient Indians, who subsisted chiefly on grains and tough or "jerked" meat ; then compare them with the civilized people of the present day, and a marked difference will be observed.

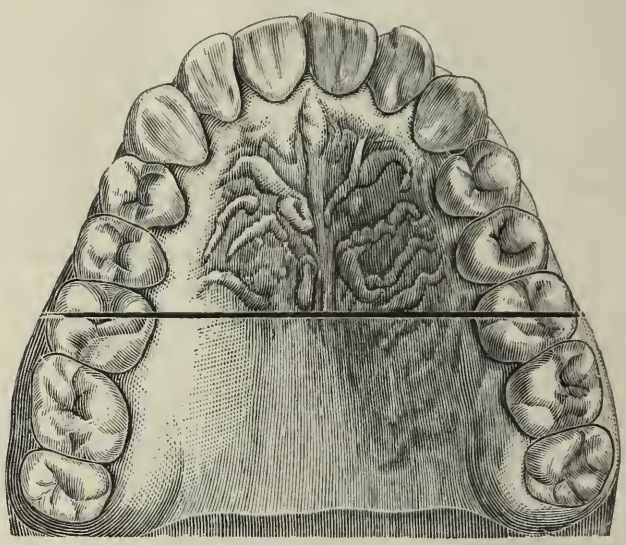
Evolutionists and scientists have frequently mentioned the fact that the jaws are changing in shape and size, but they have never produced data to show just what changes have taken place. I have therefore collected a large number of measurements for the purpose of obtaining facts in regard to these changes. The measurements of the skulls of the early races, as well as modern people, were made from specimens in the museums and crypts of churches in Europe, where large collections of skulls have been placed. In many of the museums the skulls have been classified and tabulated in such a manner that an examination of them is easily made. The large Hunter collection of skulls at the College of Surgeons in London was examined by the late Mr. John Mummery ; Dr. Betty, of Cincinnati, examined the large collection of skulls at the Smithsonian Institution in Washington ; Dr. C. N. Peirce, of Philadelphia, crania in the Academy of Natural Sciences of that city ; Dr. Schuhmann, of Chicago, crania in Rome, Italy ; Dr. Barrett, of Buffalo, crania in his private collection and in the Buffalo Academy of Natural Sciences ; Dr. Pratt, crania in the Academy of Natural Sciences of Davenport, Ia.; and I have made examinations of many skulls in different parts of Europe and also of the collection of Peruvian skulls in the Michigan University at Ann Arbor and the Peabody Museum, Harvard College.

Measurements of the jaws of living individuals of different countries and nationalities have been taken by the following dentists as well as by myself: Dr. Caracatsanis, Athens, Greece ; Drs. Franz Berggren and Elof Forberg, Stockholm, Sweden ; Dr. A. Scheller, Warsaw, Poland ; Dr. Johan Kier, Copenhagen, Denmark ; Dr. Sturpenick, Brussels, Belgium ; Dr. Ed. Wagner, North China ; Drs. Perkins and Ivy, Shanghai, China ; Dr. D. D. Bode, India ; Dr. A. W. Baker, Dublin, Ireland ; Drs. W. Barrett and Wm. Hern, London, England ; Dr. I. N. Demorest, Santiago, Chile ; Dr. Geo. Warren, Philadelphia, Pa.; Dr R. B. Winder, Baltimore, Md.; Dr. S. D. Hodge, Burlington, Vt.; Dr. W. E. Page, Boston, Mass.; Dr. C. Sill, New York, N. Y.; Drs. Geo. Crisup, Ira Cressiman, Volini, and V. D'Elia, Chicago, Ill. I wish at this point in my paper to thank those gentlemen who so kindly assisted me in the very laborious work of obtaining these measurements, thus contributing their part to the progress of science. The people whose mouths have been examined comprise individuals in the different walks of life, a part of them composing the patients of practitioners of dentistry and con-

stituting the better classes, while others are dispensary patients and from the middle and poorer classes.

The measurement was made across the upper jaw, from the outer surface of one first molar to the outer surface of the corresponding molar of the other side (Fig. 5). These points were taken because these molars are the first teeth of the permanent set to develop, and from the fact that, developing posterior to the temporary ones, they erupt independently of and are not interfered with by any of the other teeth which are in the jaw. The point of the jaw where these teeth are situated is the widest part that is normally developed and is not

FIG. 5.



influenced by local causes, therefore this position was the most accessible for the object required. The measurements were made in the mouths of persons over twenty-five years of age, irrespective of the exact age, for the reason that at this period, or nearly at this period, the individual has completed his growth. After this period the development of the skeleton is very slow, and at the age of thirty to thirty-five ceases altogether.

In securing this large collection of measurements of crania and living individuals, the compilation of which has extended over a period of eight years, I have endeavored to show by actual demonstration that the jaw of the human race is diminishing in size.

The following is the table of measurements :

in Peabody Museum, Harvard University; Academy of Natural Sciences, Philadelphia; Davenport Academy; Army Museum; Roman, French, and English Crania in European museums, and private collection of Barrett. Miscellaneous crania by Drs. Peirce, Newton, Schuhmann, Barrett, Pratt, Betty, and Talbot.

RACE.	No.	Sex.	LATERAL DIAMETER. Inches / Millimeters.																							Average.	
			1.88 47.62	1.94 49.19	2.00 50.80	2.06 52.32	2.09 53.13	2.13 53.95	2.16 54.75	2.19 55.56	2.22 56.35	2.25 57.13	2.28 57.92	2.31 58.84	2.34 59.57	2.37 60.30	2.40 60.90	2.44 61.90	2 47 62.70	2.50 63.50	2.56 65.08	2.59 65.76	2.63 66.67	2.69 68.26		
																										In.	Mm.
Europeans,—Ancient and Modern Romans, Italians, French, English	276	?	...	1	7	5	...	17	...	15	...	44	...	28	...	57	...	42	...	24	13	...	20	3	2.34	58.84
	36	M.	...	...	...	1	...	12	...	8	...	7	...	5	...	3	...	...	...	...	...	...	...	...	2.20	55.95
	30	F.	3	2	4	6	...	1	...	5	...	7	...	...	...	1	...	1	...	...	...	...	...	...	2.08	52.81
Sandwich Islanders	26	M.	...	...	...	...	...	2	...	3	...	9	...	2	...	6	...	3	...	1	...	...	...	...	2.29	58.17
	26	F.	...	...	...	2	...	8	...	2	...	9	...	4	...	1	...	...	...	...	...	...	...	...	2.20	55.95
	8	?	...	...	...	...	...	...	...	...	2	1	2	2	...	...	...	...	...	1	...	...	...	...	2.30	58.45
Ancient Peruvians	137	M.	...	...	1	8	...	14	...	13	...	31	...	22	...	23	...	17	...	6	1	...	1	...	2.30	58.45
	124	F.	2	...	2	7	...	20	...	22	...	39	...	14	...	10	...	4	...	3	1	...	...	...	2.22	56.34
	117	?	...	...	2	3	2	3	1	12	2	28	8	17	6	10	3	7	3	9	1	...	...	...	2.30	58.45
Ancient Californians, from Santa Cruz Islands, Coast of California, Santa Catalina Island, Brazil, Nicaragua, St. Miguel	34	M.	...	...	...	2	...	2	...	3	...	11	...	...	...	8	...	4	...	2	...	...	2	...	2.31	58.84
	38	F.	...	...	...	1	...	6	...	6	...	13	...	8	...	1	...	3	...	...	...	...	...	...	2.25	57.14
Mexicans	27	?	...	1	...	...	...	1	...	2	2	3	1	5	1	5	...	2	1	3	...	...	...	...	2.31	58.84
Californian Indians	29	M.	...	...	...	1	...	3	...	...	...	8	...	3	...	6	...	3	...	5	...	...	...	...	2.31	58.84
	26	F.	...	...	...	3	...	3	...	7	...	8	...	3	...	2	...	...	...	...	...	...	...	...	2.22	56.34
Mound Builders, Mounds in Kentucky and Tennessee	56	M.	...	...	...	2	...	1	...	6	...	12	...	8	...	15	...	7	...	4	...	...	1	...	2.33	59.48
	47	F.	...	...	1	...	...	3	...	8	...	14	...	7	...	10	...	2	...	2	...	...	...	...	2.28	57.92
	57	?	...	...	...	2	...	1	...	2	...	5	...	10	...	13	...	6	...	8	7	...	2	1	2.39	60.70
Stone Grave People, Cumberland Valley, Tennessee, Illinois River, Indiana, Arkansas, Michigan, and various places	87	M	...	...	...	...	...	1	...	...	...	9	...	10	...	22	...	11	...	22	3	...	7	2	2.42	61.90
	89	F.	1	...	2	...	...	7	...	7	...	31	...	10	...	23	...	6	...	2	...	...	...	...	2.28	57.92
	11	?	...	...	...	...	...	2	...	1	...	2	...	1	...	4	...	1	...	...	...	...	...	...	2.28	57.92
Indians, — North American. Different Tribes	17	M.	...	...	...	...	...	1	...	2	...	6	...	3	...	2	...	1	...	2	...	...	...	...	2.30	58.45
	11	F.	...	...	...	...	...	2	...	1	...	6	...	2	...	...	...	...	...	...	...	...	...	...	2.23	56.69
	191	?	1	...	2	1	1	10	4	20	8	22	14	21	15	16	4	24	7	16	...	3	2	...	2.31	58.84
Negro,—Rio de Favino	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.19	55.56
Total	1501		7	4	21	44	3	120	5	146	14	325	25	185	22	238	7	144	11	110	26	3	35	6		

EXAMINATION OF CRANIA—Continued.

RACE.	No.	Sex.	LATERAL DIAMETER. Inches	1.75	1.88	1.94	2.00	2.06	2.09	2.13	2.16	2.19	2.22	2.25	2.28	2.31	2.34	2.37	2.44	2.47	2.50	2.53	2.56	2.63	2.75	Average. In.	Average. Mm.
			Millimeters	44.46	47.62	49.14	50.80	52.32	53.13	53.95	54.75	55.56	56.35	57.13	57.92	58.84	59.57	60.30	61.90	62.70	63.50	64.29	65.08	66.67	69.85		
Flat Heads from Oregon, Washington, Gulf of Georgia, Peru	3	M.		...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	1	...	2.45	62.31
	2	F.		...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	2.28	57.92
	18	?		...	...	...	...	...	...	...	...	...	...	2	...	...	...	3	1	...	5	...	...	4	3	2.53	64.29
Crania from San Lorenzo Cave, Mexico	4	M.		...	...	...	..	...	...	...	...	...	...	2	...	1	...	1	...	...	...	...	...	...	...	2.30	58.45
	3	F.		...	...	...	...	...	...	2	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	2.20	55.95
Crania from Caves in Tennessee, Kentucky, Mexico	4	M.		...	...	...	...	...	...	3	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2.14	54.38
	9	?		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.23	56.69
	3	F.		...	...	...	...	1	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	2 19	55.56
Esquimaux from Labrador, Norton Sound	40	?		1	1	...	2	1	1	4	...	4	3	5	...	2	2	6	1	1	1	1	3	1	...	2.23	56.69
	2	M.		...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	2.28	57.92
Hindoos	1	M.		...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.13	53.95
	1	?		...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	2.22	56.34
	3	F.		...	...	...	...	1	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	2.25	57.14
Herney Islanders	3	M.		...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	1	...	...	...	...	2.33	59.13
	1	?		...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.13	53.95
Hawaiian Islander	1	M.		...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	2.31	58.84
Negroes, African Negroes	2	M.		...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	2.31	58.84
	79	?		...	1	1	...	2	1	7	5	7	6	12	8	9	7	7	5	1	...	...	...	...	...	.....	57.58
	1	F.		...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	2.25	57.14
Zulus, South Africa	1	F.		..	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	2.25	57.14
	1	M.		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	2.44	61.90
Probably Africans	2	F.		...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	2.13	53.95
Negro Giles executed at Richmond, Va.	1	M.		...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	2 31	58.45
Aleutian Islander	1	F.		...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.13	53.95
Guanche	1	F.		...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.06	52.58
Pegu, Burmah	1	F.		...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2.19	55.56
Mauritian Dwarf	1	?		...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2.19	55.56
Unknown	3	M.		...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1	...	...	...	...	...	...	2.37	60 30
	5	F.		...	1	...	1	...	...	...	...	1	...	1	...	1	...	...	...	...	...	...	...	...	...	2.13	53.95
Total	197			1	3	1	4		2	21	5	16	10	30	8	18	9	20	10	2	9	1	3	6	3		

EXAMINATION OF CRANIA—Continued.

RACE.	No.	Sex.	LATERAL DIAMETER. Inches	1.88	1.94	1.97	2.00	2.03	2.06	2.09	2.13	2.16	2.19	2.22	2.25	2.28	2.31	2.34	2.37	2.40	2.44	2.47	2.50	2.53	2.56	2.69	Average. In.	Average. Mm.
			Millimeters.	47.62	49.25	50.07	50.80	51.56	52.36	53.13	53.95	54.75	55.56	56.35	57.13	57.92	58.84	59.57	60.30	60.90	61.90	62.70	63.50	64.29	65.08	68.26		
Fiji Islanders	2	?	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	2.37	60.30
Loo Choo Islander	1	?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	2.37	60.30
Burmese	1	?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	2.47	62.70
Marquesas Islanders	4	?	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	2	...	1	...	...	...	...	...	2.36	59.91
Assiniboin	3	?	...	...	...	...	...	...	...	...	...	...	...	1	1	...	1	...	...	...	...	...	...	...	...	2.31	58.84
Kanakee	5	?	...	...	...	...	...	...	...	...	1	...	...	2	...	2	...	...	...	...	...	...	...	...	...	2.25	57.14
Malay	13	?	...	...	...	...	...	...	...	...	1	...	1	...	...	2	...	2	1	3	2	...	1	...	...	2.37	60.30
Tahitian	2	?	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	2.36	59.91
Tatlit Koochin	2	?	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	2.28	57.92
Laplanders	2	?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	2.44	61.90
Japanese	1	?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	2.37	60.30
Parsee	2	?	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.98	50.40
Australians	10	?	...	...	...	...	...	...	1	...	...	1	2	1	...	3	...	...	...	...	1	...	...	...	1	2.31	58.84
Armenians	4	?	...	...	...	1	1	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.06	52.29
Samoan Islander	1	?	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	2.25	57.13
Ancient Egyptian (Egyptian Type)	18	?	1	...	...	2	...	2	1	1	1	1	2	2	...	2	1	...	...	...	1	1	...	...	...	2.20	55.95
Ancient Egyptian (Negroid Type)	11	?	...	...	...	...	...	...	...	2	...	1	...	...	...	...	1	3	1	...	...	2	...	...	1	2.37	60.30
Copt	1	?	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.13	55.95
Egyptian Negroes	3	?	1	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.01	51.05
Ancient Egyptians	27	?	1	1	3	3	1	5	...	8	3	1	1	...	...	...	...	...	...	...	...	...	...	...	...	2.06	52 59
Arab	2	?	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	2.25	57.14
Choctaw and Negro	1	?	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2.19	55.56
Hispano-Peruvian	2	?	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	2.17	55.16
Dutch	1	?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	2.56	65.08
Anglo-American	1	?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	2.50	63.50
Recent Crania, Pa. (?)	22	?	...	...	1	...	...	...	...	1	...	2	1	4	1	...	...	4	1	3	2	2	...	...	...	2 30	58.45
Total	142		3	1	5	7	3	7	4	15	6	8	9	11	3	12	3	15	3	8	8	7	1	1	2		

EXAMINATION OF CRANIA—Continued.

RACE.	No.	Sex.	ANTERO-POSTERIOR DIAMETER. Inches / Millimeters.	1.38	1.50 38.10	1.56 39.69	1.63 41.28	1.64 41.65	1.66 42.11	1.67 42.42	1.69 42.86	1.75 44.46	1.78 45.25	1.81 46.04	1.84 46.83	1.88 47.62	1.91 48.38	1.94 49.14	1.97 50.07	2.00 50.80	2 03 51.56	2.06 52.32	2.10 53.13	2.13 53.95	2.16 54.75	2.19 55.56	2.25 57	2.31 58.69	Average. In.	Average. Mm.
Europeans,—Ancient and Modern Romans; Lake Dwellers; French prior to nineteenth century	31	M.		...	...	...	..	...	...	...	4	3	...	7	...	8	...	2	...	7	...	...	...	...	...	...	...	...	1.86	47.23
	30	F.		...	...	1	2	...	...	...	3	4	...	3	...	4	...	5	...	2	...	1	...	...	..	...	...	...	1.83	46.43
Sandwich Islanders	26	M.		...	...	...	1	...	...	...	1	1	...	4	...	5	...	4	...	6	1	2	...	...	...	1	...	...	1.91	48.38
	29	F.		...	...	...	1	...	...	...	3	6	...	7	...	6	..	2	...	3	1	...	...	...	...	...	...	...	1.83	46.43
Ancient Peruvians	122	M.		...	...	1	1	...	...	...	6	21	...	20	...	21	...	17	...	27	...	6	...	2	...	...	...	...	1 88	47.62
	104	F.		...	...	4	4	...	...	...	9	22	...	16	...	27	...	16	...	4	...	1	...	1	...	...	...	...	1.79	45.64
	2	?		...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1.84	46.83
Ancient Californians	26	M.		...	...	...	1	...	...	...	...	4	..	6	...	5	...	2	...	2	...	5	...	1	...	...	...	...	1.89	48.02
	32	F.		...	...	...	...	...	...	...	1	7	...	7	...	7	...	3	...	6	...	1	...	...	...	...	...	...	1.86	47.23
	130	?		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.83	46.40
Californian Indians	32	M.		...	...	...	...	...	...	...	1	5	...	2	...	4	1	8	...	9	...	1	...	1	...	...	...	...	1.91	48.38
	30	F.		..	...	...	...	...	...	...	2	6	...	9	...	8	2	2	...	1	...	...	...	...	...	...	...	...	1.83	46.43
Mound Builders	157	M.		...	...	1	1	...	...	...	...	8	...	15	...	25	...	18	7	32	5	12	7	14	3	3	...	1	2.00	50.80
	83	F.		...	...	...	1	...	...	...	3	6	...	15	...	15	...	10	4	16	1	7	...	4	...	...	...	...	1.89	48.02
	1	?		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	2.00	50.80
Stone Grave People, Cumberland Valley	83	M		...	...	...	1	...	...	...	3	3	...	10	...	7	...	14	...	21	...	13	...	6	...	4	1	...	1.97	50.00
	80	F.		...	...	...	1	...	...	...	2	9	...	14	...	16	...	11	...	21	...	6	...	...	...	...	...	...	1.91	48.41
	7	?		...	...	...	...	...	...	...	...	...	..	...	...	3	...	2	...	2	...	...	...	...	...	...	...	...	1.94	49.21
Indians	110	M.		...	...	...	...	...	...	...	...	4	...	5	...	15	2	10	4	22	6	20	10	14	...	4	3	1	1.99	50.55
	58	F.		1	1	...	...	1	2	1	...	5	1	4	1	10	1	5	...	11	1	6	3	...	2	...	1	1	1.87	47.44
	3	?		...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1.91	48.38
Negro,—Rio de Favino	1	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	2.06	52.32
Total	1177			1	1	7	14	1	2	1	39	114	1	146	1	186	6	132	15	194	15	82	20	43	5	12	5	3		

EXAMINATION OF CRANIA—Continued.

RACE.	No.	Sex.	ANTERO-POSTERIOR DIAMETER. Inches / Millimeters	1.63 / 41.28	1.69 / 42.86	1.75 / 44.46	1.81 / 46.04	1.88 / 47.62	1.94 / 49.14	2.00 / 50.80	2.06 / 52.32	2.13 / 53.95	2.19 / 55.56	2.25 / 57.13	Average. In.	Average. Mm.
Flat Heads from Oregon, Washington, Gulf of Georgia, Peru	3	M.		...	...	...	...	2	...	...	...	...	...	1	2.00	50.80
	2	F.		...	...	...	...	1	...	1	...	...	...	...	1.94	49.21
	1	?		...	...	...	...	...	...	1	...	...	...	...	2.00	50.80
Crania from San Lorenzo Cave, Mexico	4	M.		...	1	...	2	...	...	1	...	...	...	...	1.83	46.43
	3	F.		...	...	1	1	...	1	...	...	...	...	...	1.83	46.43
Crania from Caves in Tennessee, Kentucky, Mexico	4	M.		...	1	...	2	1	...	...	...	...	...	...	1.79	45.64
		?		...	...	...	...	...	...	...	...	...	...	...	.....	.....
	3	F.		...	...	2	...	...	...	1	...	...	...	...	1.83	46.43
Esquimaux from Labrador, Norton Sound		?		...	...	...	...	...	...	...	...	...	...	...	.....	.....
	7	M.		...	1	1	1	1	2	...	...	1	...	...	1.72	43.65
Hindoos	4	M.		...	1	1	...	1	...	1	...	...	...	...	1.69	42.86
		?		...	...	...	...	...	...	...	...	...	...	...	.....	.....
	2	F.		...	...	...	2	...	...	...	...	...	...	...	1.81	46.04
Herney Islanders	3	M.		...	...	...	...	2	...	1	...	...	...	...	1.92	48.81
		?		...	...	...	...	...	...	...	...	...	...	...	.....	.....
Hawaiian Islander	1	M.		...	...	...	...	...	...	1	...	...	...	...	2 00	50.80
Negroes, African Negroes	2	M.		...	...	...	...	...	...	...	1	1	...	...	2.09	53.18
		?		...	...	...	...	...	...	...	...	...	...	...	.....	.....
		F.		...	...	...	...	...	...	...	...	...	...	...	.....	.....
Zulus, South Africa	1	F.		...	...	...	...	...	1	...	...	...	...	...	1.94	49.21
	1	M.		...	...	...	...	...	...	1	...	...	...	...	2.00	50.80
Probably Africans		F.		...	...	...	...	...	...	...	...	...	...	...	.....	.....
Negro Giles executed at Richmond, Va	1	M.		...	...	...	...	...	...	...	...	...	1	...	2.19	55.56
Aleutian Islander	1	F.		...	...	...	...	...	...	...	...	1	...	...	2.13	53.98
Guanche	1	F.		1	...	...	...	...	...	...	...	...	...	...	1.63	41.28
Pegu, Burmah	1	F.		...	...	...	...	1	...	...	...	...	...	...	1.88	47.62
Mauritian Dwarf	1	?		...	...	...	...	...	...	...	...	1	...	...	2.13	53.98
Unknown	3	M.		...	...	...	1	...	...	1	1	...	...	...	1.95	49.60
	5	F.		...	1	...	...	1	1	2	...	...	...	...	1.91	48.41
Total	54			1	5	5	9	10	5	11	2	4	1	1		

EXAMINATION OF CRANIA—Continued.

RACE.	No.	Sex.	ANTERO-POSTERIOR DIAMETER. Inches	1.56	1.75	1.81	1.84	1.88	1.91	1.94	2.00	2.01	2.03	2.06	2.09	2.13	2.16	2.19	2.25	2.28	Average. In.	Average. Mm.
			Millimeters.	39.69	44.46	46.04	46.74	47.62	48.23	49.25	50.80	51.05	51.56	52.32	53.19	53.95	54.75	55.56	57.13	57.92		
Fiji Islanders	1	M.																		1	2.28	57.92
	1	F.													1						2.09	53.19
Bavarian	1	M.														1					2.13	53.95
	1	F.			1																1.81	46.04
New Zealanders	3	M.	1										1			1					1.92	48.76
	3	F.		1								1	1								1.93	49.00
Austrians	3	M.							2	1	1										1.96	49.78
	3	F.		1				1								1					1.94	49.25
Chinese	1	M.													1						2.09	53.19
	1	F.							1												1.94	49.25
Japanese	1	M.						1													1.91	48.23
	1	F.												1							2.06	52.32
Australians	1	M.																	1		2.25	57.13
	2	F.		1																1	2.01	51.05
Samoan Islander	1	M							1												1.94	49.25
Gallo-Roman	1	M.								1											2.00	50.80
	1	F.					1														1.88	47.62
Romano-British	1	F.				1															1.84	46.74
Whites	3	M.		1									1		1						1.98	50.29
	1	F.															1				2.19	55.56
Egyptian	1	F.			1																1.81	46.04
American Negroes	3	M.										1				1	1				2.13	53.95
	3	F.											2		1						2.08	52.73
Total	38		1	4	2	1	1	2	4	2	2	3	4	2	5	1	2	1	2			

EXAMINATION OF CRANIA—Continued.

RACE.	No.	Sex.	HEIGHT OF VAULT. Inches / Millimeters	.25 / 6.35	.31 / 7.62	.37 / 9.39	.41 / 10.45	.44 / 11.17	.47 / 11.93	.50 / 12.70	.53 / 13.46	.56 / 14.23	.59 / 14 98	.63 / 16.	.66 / 16.78	.69 / 17.52	.72 / 18.29	.75 / 19.05	.81 / 20.57	.88 / 22.35	AVERAGE. In.	AVERAGE. Mm.
Europeans,—Ancient and Modern Romans; Lake Dwellers; French prior to nineteenth century	34	M.		1	...	1	2	7	3	9	2	5	1	3	...	2	...	...	...	...	.53	13.46
	30	F.		...	1	1	...	9	1	13	1	3	...	1	...	...	...	...	...	...	.48	12.19
Sandwich Islanders	25	M.		...	...	1	...	3	...	7	...	5	...	6	1	1	...	1	...	...	.55	13.97
	26	F.		...	1	1	...	4	...	6	1	8	1	3	...	1	...	...	...	...	.52	13.21
Ancient Peruvians	137	M.		1	...	1	1	11	2	25	10	29	9	20	4	16	2	4	2	...	.57	14.47
	124	F.		...	...	4	1	13	1	27	6	29	7	19	6	8	...	3	...	...	.57	14.47
	17	?		...	...	...	...	6	...	8	...	1	...	2	...	...	...	...	...	...	.49	12.45
Ancient Californians	34	M.		...	...	...	...	4	1	6	2	11	1	7	1	1	...	...	...	...	.55	13.97
	38	F.		...	...	...	...	4	1	6	5	14	2	4	...	1	...	1	...	...	.55	13.97
Californian Indians	29	M.		...	...	...	1	5	...	5	...	10	2	5	...	1	...	...	...	...	.54	13.71
	26	F.		...	...	...	...	6	1	7	2	7	...	2	...	1	...	...	...	...	.52	13.21
Mound Builders	56	M.		...	...	...	...	1	...	14	2	14	3	14	1	4	3	...	...	...	.55	13.97
	47	F.		...	...	...	...	7	1	5	5	12	2	12	1	2	...	...	...	...	.56	14.23
	7	?		...	...	...	1	2	...	1	1	...	1	...	1	...	...	...	...	...	.51	12.95
Stone Grave People, Cumberland Valley	87	M.		...	...	...	1	4	1	10	8	12	6	19	8	9	3	4	1	1	.60	15.02
	89	F.		...	...	1	2	10	5	11	10	19	3	21	3	2	...	2	...	...	.55	13.97
	11	?		...	...	1	...	2	1	2	1	4	...	...	...	...	...	...	...	...	.50	12.70
Indians	17	M.		...	...	...	...	1	...	3	1	2	5	4	...	1	...	...	...	...	.57	14.47
	11	F.		...	...	...	3	1	5	...	1	...	1	...	...	...	...	...	...	...	.47	11.93
	3	?		...	...	...	...	...	...	1	...	1	...	1	...	...	...	...	...	...	.56	14.23
Negro,—Rio de Favino	1	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.50	12.70
Total	859			2	2	11	12	100	23	166	58	186	44	143	26	50	8	15	3	1		

EXAMINATION OF CRANIA—Continued.

RACE.	No.	Sex.	HEIGHT OF VAULT. Inches / Millimeters	.31 / 7.62	.44 / 11.17	.47 / 11.93	.50 / 12.70	.53 / 13.46	.56 / 14.23	.59 / 14.98	.63 / 16.00	.66 / 16.78	.69 / 17.52	.75 / 19.05	Average. In.	Average. Mm.
Flat Heads from Oregon, Washington, Gulf of Georgia, Peru	3	M.		...	...	...	1	...	...	...	...	...	1	1	.65	16.51
	2	F.		...	...	...	1	...	1	...	...	...	...	...	.53	13.46
	1	?		...	...	...	1	...	...	...	...	...	...	...	.50	12.70
Crania from San Lorenzo Cave, Mexico	4	M.		...	...	...	1	...	1	...	1	...	1	...	.60	15.02
	3	F.		...	1	...	....	1	...	...	...	1	...	...	.54	13.71
Crania from Caves in Tennessee, Kentucky, Mexico	3	M.		...	...	...	...	3	...	...	...	...	...	...	.53	13.46
	?			...	...	...	...	...	...	...	...	...	...	...	....	.....
	3	F.		...	...	1	...	2	...	...	...	...	...	...	.51	12.95
Esquimaux from Labrador, Norton Sound	?			...	...	...	...	...	...	...	...	...	...	...	....	. .....
	2	M.		...	...	...	1	...	1	...	...	...	...	...	.53	13.46
Hindoos	1	M.		...	...	...	1	...	...	...	...	...	...	...	.50	12.70
	?			...	...	...	...	...	...	...	...	...	...	...	....	.....
	3	F.		...	1	...	...	...	...	...	1	...	1	...	.60	15.02
Herney Islanders	3	M.		...	1	...	...	...	...	...	2	...	...	...	.57	14.47
	?			...	...	...	...	...	...	...	...	...	...	...	....	.....
Hawaiian Islander	1	M.		...	...	...	...	...	...	...	1	...	...	...	.63	16.00
Negroes, African Negroes	2	M.		...	...	...	...	1	...	...	1	...	...	...	.57	14.47
	?			...	...	...	...	...	...	...	...	...	...	...	....	.....
	1	F.		...	1	...	...	...	...	...	...	...	...	...	.44	11.17
Zulus, South Africa	1	F.		...	...	...	1	...	...	...	...	...	...	...	.50	12.70
	1	M.		...	...	...	...	...	...	...	...	...	...	1	.75	19.05
Probably Africans	2	F.		...	1	...	1	...	...	...	...	...	...	...	.47	11.93
Negro Giles executed at Richmond, Va	1	M.		...	...	...	1	...	...	...	...	...	...	...	.50	12.70
Aleutian Islander	1	F.		1	...	...	...	...	...	...	...	...	...	...	.31	7.62
Guanche	1	F.		...	1	...	...	...	...	...	...	...	...	...	.44	11.17
Pegu, Burmah	1	F.		...	...	...	1	...	...	...	...	...	...	...	.50	12.70
Mauritian Dwarf	1	?		...	...	...	1	...	...	...	...	...	...	...	.50	12.70
Unknown	3	M.		...	...	...	...	2	1	...	...	...	...	...	.54	13.71
	5	F.		...	...	...	...	3	...	1	...	...	1	...	.57	14.47
Total	49			1	6	1	11	12	4	1	6	1	4	2		

EXAMINATION OF THE CRANIA

of Modern Races and Ancient Races in the Hunterian Museum by Dr. Mummery.* Also crania in the Oxford University Museum, and in a number of private collections.

MODERN RACES.	No.	LATERAL DIAMETER. MINIMUM.		LATERAL DIAMETER. MAXIMUM.	
		In.	Mm.	In.	Mm.
Esquimaux	69	2.375	60.32	2.75	69.85
N. Americans (Coast)	56	2.375	60.32	2.75	69.85
N. Americans (Interior)	23	2.375	60.32	2.625	66.68
S. Americans (Chile)	19	2.50	63.50	2.75	69.85
Fiji Islanders	38	2.50	63.50	2.875	73.02
Polynesians (Various)	79	2.375	60.32	2.625	66.68
Sandwich Islanders	21	2.375	60.32	2.625	66.68
New Zealanders	67	2.50	63.50	2.875	73.02
Australians	132	2.375	60.32	2.75	69.85
Tasmanians	33	2.375	60.32	2.625	66.68
Malays	24	2.375	60.32	2.75	69.85
Chinese	27	2.25	57.14	2.625	66.68
East Indians (North)	152	2.25	57.14	2.75	69.85
East Indians (South)	71	2.125	53.97	2.50	63.50
Africans (East)	33	2.125	53.97	2.75	69.85
Caffres	49	2.375	60.32	2.875	73.02
Bosjesmen and Hottentots	29	2.125	53.97	2.375	60.32
Africans (West)	236	2.25	57.14	2.75	69.85
Ashantees	92	2.50	53.50	2.875	73.02
Total No.	1250				

ANCIENT RACES.	No.	LATERAL DIAMETER. MINIMUM.		LATERAL DIAMETER. MAXIMUM.	
		In.	Mm.	In.	Mm.
Ancient Britons (Dolichocephalic)	68	2.125	53.97	2.625	66.68
Ancient Britons (Brachycephalic)	32	2.125	53.97	2.50	63.50
Ancient Britons (Canon Greenwell's Explorations)	59	2.125	53.97	2.50	63.50
Ancient Britons (Miscellaneous)	44	2.125	53.97	2.50	63.50
Romano-Britons	143	2.125	53.97	2.625	66.68
Anglo-Saxons	76	2.25	57.14	2.625	66.68
Ancient Egyptians	36	2.125	53.97	2.625	66 68
	...	...	...	...	...
	...	...	...	...	...
	...	...	...	...	...
	...	...	...	...	...
	...	...	...	...	...
	...	...	...	...	...
	...	...	...	...	...
Total	458				

RACE.	ANTERO-POSTERIOR. Inches	1.75	2.	2.07	AVERAGE.	
	Millimeters.	44.46	50.80	52.29		
	No.				In.	Mm.
Marshpee Indians	34	6	17	11	1.98	50.27

RACE.	HEIGHT OF VAULT. In.	.41	.50	.59	.63	AVERAGE.	
	Mm.	10.45	12.70	14.98	16.		
	No.					In.	Mm.
Marshpee Indians	46	9	25	4	8	.51	12.95

* These measurements were made about 1860. These being the first made, only the maximum and minimum figures are given, instead of presenting the entire measurements in a table, which would have been more scientific.

EXAMINATION OF THE MOUTHS OF LIVING PERSONS, SHOWING MEASUREMENTS OF LATERAL DIAMETER OF THE SUPERIOR MAXILLA.

RACE.	No.	Sex.	LATERAL DIAMETER. Inches / Millimeters: 1.75 / 44.46	1.88 / 47.62	1.94 / 49.25	1.97 / 50.02	2.00 / 50.80	2 02 / 51.3	2.05 / 52.07	2.07 / 52.50	2.09 / 53.19	2.13 / 53.95	2.15 / 54.6	2.17 / 55.16	2.20 / 56.00	2.25 / 57.13	2.28 / 57.92	2.31 / 58 84	2.34 / 59.57	2 37 / 60.30	2.40 / 61.00	2.44 / 62.00	2.46 / 62.5	2.48 / 63.00	2.52 / 64.00	2.56 / 65.00	2.60 / 66.00	2.63 / 66.67	Average. In.	Average. Mm.
Residents of Athens, Greece	15	M.	1	1	2	4	1	4	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.98	50.40
	14	F.	4	5	3	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.90	48.23
Stockholm, Sweden	393	M.	...	2	6	19	...	7	11	...	23	30	...	28	36	51	33	35	...	30	20	23	...	12	7	8	6	6	2.26	57.37
	194	F.	3	3	8	16	...	18	11	...	13	25	...	15	13	25	19	12	...	9	1	1	...	...	1	...	1	...	2.15	54.6
Copenhagen, Denmark	250	M.	1	4	...	6	...	5	11	...	18	12	...	32	24	21	24	25	...	50	...	...	11	...	...	6	...	...	2.24	56.82
	50	F.	1	1	...	2	...	1	6	...	4	6	...	2	11	7	6	...	...	2	...	...	1	...	...	...	...	...	2.18	55.72
Brussels, Belgium	148	M.	...	...	...	2	...	...	...	...	10	6	3	...	22	14	23	14	1	25	7	5	3	1	1	1	...	...	2.25	57.05
	158	F.	2	...	1	4	...	3	8	1	20	6	14	20	19	18	19	6	1	8	3	1	...	1	1	1	1	...	2.18	55.57
Warsaw, Poland	150	M.	...	...	...	...	...	1	1	...	...	...	5	5	11	16	23	28	...	24	14	10	...	7	3	1	1	...	2.31	58.84
	150	F.	...	...	2	4	...	5	12	...	19	...	19	24	12	14	18	...	18	...	3	...	...	..	...	...	...	...	2.17	55.16
China	72	M.	...	...	...	...	10	...	...	...	...	9	...	2	1	9	7	7	...	17	6	4	...	...	...	...	...	...	2.26	57.37
	22	F.	...	...	...	...	6	...	...	...	...	3	...	...	2	3	3	2	...	2	...	...	...	...	1	...	...	...	2.19	55.56
Typical People of India	46	M.	...	...	2	...	6	...	...	6	...	15	...	...	9	6	...	1	...	1	...	...	...	...	...	...	...	...	2.13	53.95
	3	F.	...	...	1	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.00	50.80
Italians	666	M.	...	...	11	...	17	...	...	300	...	75	...	...	41	48	...	79	...	23	...	19	...	20	20	6	...	7	2.17	55.16
	189	F.	...	44	41	...	56	...	...	17	...	15	...	...	2	8	...	5	...	...	...	1	...	...	...	...	...	...	2.00	50.80
Santiago, Chile	106	M.	4	...	...	9	5	...	8	...	15	5	...	15	7	12	4	4	7	...	2	...	...	...	...	...	...	...	2.11	53.57
	154	F.	20	12	1	25	14	...	25	...	9	5	...	23	3	...	4	5	8	...	...	...	...	...	...	...	...	...	2.04	51.78
London, England	203	M.	...	1	1	...	7	...	...	15	...	31	...	...	26	29	...	30	...	22	...	15	...	6	5	9	...	8	2.28	57.92
	187	F.	...	8	19	...	29	...	...	40	...	33	...	...	20	15	...	7	...	4	...	2	...	...	...	...	...	...	2.09	53.19
Dublin, Ireland	86	M.	...	3	4	...	2	...	...	5	...	10	...	...	12	17	...	6	...	18	...	3	...	3	2	...	...	1	2.25	57.13
	126	F.	...	8	10	...	25	...	...	17	...	23	...	...	7	21	...	8	...	5	...	...	...	1	1	...	...	...	2.11	53.58
American-born Negroes	128	M.	...	...	...		...	...	...	3	...	11	...	...	11	6	...	33	...	47	...	10	...	4	3	...	...	...	2.32	58.92
	108	F.	...	...	...	3	1	...	...	17	...	5	...	...	33	35	...	17	...	...	...	...	...	...	...	...	...	...	2.20	55.9
Dispensary patients of Philadelphia, Baltimore, and Boston	463	M.	...	7	7	3	60	...	...	115	...	101	...	...	70	47	...	20	...	21	...	4	...	4	2	2	...	...	2.14	54.33
	241	F.	12	38	42	...	56	...	...	28	...	23	...	...	13	13	...	3	...	7	...	1	...	...	1	...	...	1	2.01	50.9
Residents of Burlington, Vt.	52	M.	...	...	...	60	7	...	...	6	...	8	...	...	9	11	...	6	...	5	...	...	...	...	...	...	...	...	2.19	55.56
	50	F.	...	5	9	...	11	...	...	10	...	8	...	...	7	...	...	...	...	...	...	...	...	...	...	...	...	...	2.02	51.31
Boston, Mass.	896		...	...	76	...	180	170	...	164	50	160	...	1	34	...	...	1	...	...	...	...	...	...	...	...	...	...	2.04	51.80
New York City	47	M.	1	1	...	...	2	...	...	4	...	12	...	...	11	9	...	4	...	1	...	1	...	...	1	...	...	...	2.18	55.72
	56	F.	2	3	2	...	8	...	...	9	...	10	...	...	8	7	...	3	...	2	...	...	...	...	...	...	...	...	2.10	53.36
Chicago	51	M.	...	...	...	...	2	...	...	5	...	12	...	...	7	5	...	11	...	7	...	1	...	...	...	1	...	...	2.22	56.34
	51	F.	...	1	3	...	8	...	...	5	...	15	...	...	6	14	...	8	...	1	...	...	...	...	...	...	...	...	2.14	54.33
Chicago and Illinois	1696	M.	8	19	122	...	163	...	...	316	...	352	...	...	211	197	...	173	...	19	...	12	...	2	2	...	...	...	2.12	53.76
	1116	F.	1	31	146	...	342	...	...	292	...	147	...	...	27	21	...	5	...	1	...	...	...	2	1	...	...	...	2.02	51.31
Marshpee Indians	55	M.	...	...	...	...	12	...	...	6	...	...	...	...	9	10	...	...	...	...	...	...	...	9	9	...	...	...	2.24	56.90
	6	F.	...	...	...	...	...	...	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.07	52.5
	8398		60	97	519	158	1031	215	94	1388	181	1144	41	167	734	709	183	558	35	351	56	113	15	72	62	35	9	23		

While one would naturally expect to find discrepancies in the figures in a work like this, in which so many different individuals have been engaged, great care was exercised in selecting gentlemen (most of whom are personal friends of mine and well known in the profession) who possessed skill and who had also attained prominence in their calling.

In comparing the measurements of living individuals with those of the crania, an allowance of .06 of an inch should be made for thickness of the mucous membrane.

The measurements have been given in detail, with the exception of those of the late Dr. Mummery, who reported only the maximum and minimum measurements. I regret that these were not given in detail. A table containing only the maximum and minimum and average measurements would be of less value to scientists, who prefer to compare the differences themselves. The difference in the number of measurements of the antero-posterior and the lateral diameter is due to the fact that in many cases the antero-posterior diameter was taken from the first and second molars instead of from the third ; it was necessary to reject all such measurements.

We must therefore look upon these figures as being nearly correct in each individual case, because the work is positive in its nature, and the figures are simply a matter of record as presented by the instrument.

Mouths of Living Persons—Lateral Diameter.

A careful study of the table will show that the diameter of the jaws depends to a great extent upon the size of the skeleton ; thus a small person will possess a small jaw, a large person a large jaw. This, however, is not invariable. We frequently find small people with large jaws, like the Cretins of Switzerland, and large people with small jaws, as is frequently observed in limestone countries. This condition is also frequently due to excessive or arrested development of the maxillæ. We notice that there is as marked a difference between the size of the jaws of the male and female as there is in the size of the skeleton of the two sexes. This difference ranges from .02 to .16 of an inch, and is characteristic not only of living individuals, but it was also observed in the measurements of the crania of the ancient races.

We also note that the lateral diameter of the jaws of living persons in the old country is greater, with the exception of the Athenians, than it is in this country at the present time, and the jaws of the native Indian races of this country are much larger than the jaws of the white people at the present time. The jaws of the people in older parts of this country are smaller than the jaws of people in the newer parts, as illustrated in the measurements of the jaws of the residents of Boston and those of Chicago.

There is also a marked difference between the diameters of the jaws of dispensary patients and poorer patients, and those observed in private practice among the wealthier classes. This is well illustrated in the measurements of patients by Dr. Cressiman and those measured by the author. The patients of Dr. Cressiman belong to the middle class, and many of them are of foreign birth, either German or Swede.

This is also well illustrated in measurements by the author, of patients in the office of Dr. Shepard, of Boston, and those made by Dr. W.

E. Page, of Boston, Dr. Winder, of Baltimore, and Dr. Warren, of Philadelphia, who made examinations of dispensary patients. A very interesting point to be noticed is that the purer and more clannish the race, the smaller the range in the figures representing the diameters of the jaws.

Thus we see in the measurements of the jaws of the Chinese the range is only from 2 to 2.44, with one measurement at 2.52 ; the people of India, 1.94 to 2.37 ; the negro, 2.07 to 2.50 ; the Marshpee Indians, 2.00 to 2.50 ; while in the mixed races the range is from 1.50 to 2.75, extending over a much greater latitude than in the pure races. Thus in the Swedes we notice that the range is from 1.81 to 2.63 ; in Dublin from 1.88 to 2.50 ; in London from 1.88 to 2.44 ; while the range of the white people in America is from 1.50 to 2.63. This disparity in the size shows that in mixed races and those of a nervous temperament the arrest of development and excessive development of the jaws are very common ; while on the other hand, in those races whose customs have been the same for hundreds of years, where the soil, climate, and environments have been unchanged, who have intermarried among themselves, very little difference in the size of the jaws is noticed. There is also a difference noticed in people who live at different heights of the same country, as in Northern and Southern Italy and in different parts of America.

It is not necessary to take measurements of different nationalities to show that the jaws are diminishing in size, but simply compare the measurements of the jaws of the same nationality at different periods of its history. Thus the early Briton possessed jaws which measured from 2.12 to 2.50 in their lateral diameters, while the jaws of the present English people measure from 1.88 to 2.44 inches. It will be noticed that the minimum diameter has decreased more than the maximum. Again, by comparing the ancient Romans with the modern Italians of Southern Italy, we find that the jaws of the early Romans measured from 2.12 to 2.62, while the jaws of the present Southern Italians measure only 1.94 to 2.69.

In comparing the measurements of the uncivilized races with those of the civilized, it will be observed that the jaws of the former are much larger than those of the latter. In the majority of cases the size and shape of the jaw are commensurate with the osseous structure of the individual. The Bosjesmen and Hottentots present the smallest range in the size of the jaw, 2.12 to 2.37 inches. As is well known, they are the most inferior of races (with the exception of the Australians), mentally and physically. They are nomadic in habit, and are often driven from place to place by stronger tribes. Their food often consists for some time of herbs, roots, berries, plantain, etc. Their meat consists chiefly of rats, dogs, etc., and they are obliged sometimes to feed upon locusts, ants, lizards, and frogs. This mode of life is as artificial in one direction as is the life of the present highly civilized races in the opposite direction. The people dwell along the banks of rivers, near marshes, where hygienic surroundings are wanting.

The Chinese live under artificial conditions also, and the size of their jaws ranges from 2.25 to 2.62 inches. Of the East Indians, those living in the north are of tall stature and well developed. They live on the high plateaus, while those in the south live in valleys. The physical

development of the latter is less, and their maxillæ are smaller than the former.

The Esquimaux are of short stature, but of remarkably well developed physique. Their maxillæ are large in proportion to the osseous development.

The Australians are the lowest types of mankind, and their jaws range from 2.37 to 2.75 inches. The jaws are very large in proportion to the size of the cranium. The Fiji Islanders and the New Zealanders are among the best developed, physically, of any of the races, past or present. Their jaws are large, ranging from 2.50 to 2.75 inches. Very few cases of caries were found by Dr. Mummery. The Polynesians and Sandwich Islanders are slightly inferior to the former, and we find this inferiority marked in the jaws also.

The South Americans from Chile, occupying the western side of the Andes, are descended from Spanish and Indian ancestors. Their teeth are very large. The North American Indians present very large jaws. They are well developed physically also. Among the ancient Britons, we would expect to find that the dolichocephalic maxillæ were narrower in proportion to the length, and the brachycephalic maxillæ broader. The length of the maxillæ has not been given, consequently the relative proportion of length and breadth cannot be determined, but we notice that the maximum brachycephalic jaw is 2.50 inches, while that of the dolichocephalic is 2.75 inches. The brachycephalic Britons were more civilized than the former, and lived under more artificial conditions, which fact will help sustain the theory advanced by me that the higher civilization is attended with lessened development of the maxillæ.

Comparing the ancient races with the modern races, we find the range of the former is 2.12 to 2.62 inches, while that of the modern is 2.12 to 2.87 inches. Only three of the modern races, however, have a minimum of 2.12, while the minimum of all the ancient races, with the exception of the Anglo-Saxons, is 2.12 inches. The maximum of the ancient races is less than that of the former. This fact, that the jaws of these people are smaller than those of the modern races, is another proof of the truth of the theory that civilization is accompanied by decrease in the size of the jaws ; for these ancient races were possessed of a higher civilization than the modern races, who with few exceptions are in a state of barbarism.

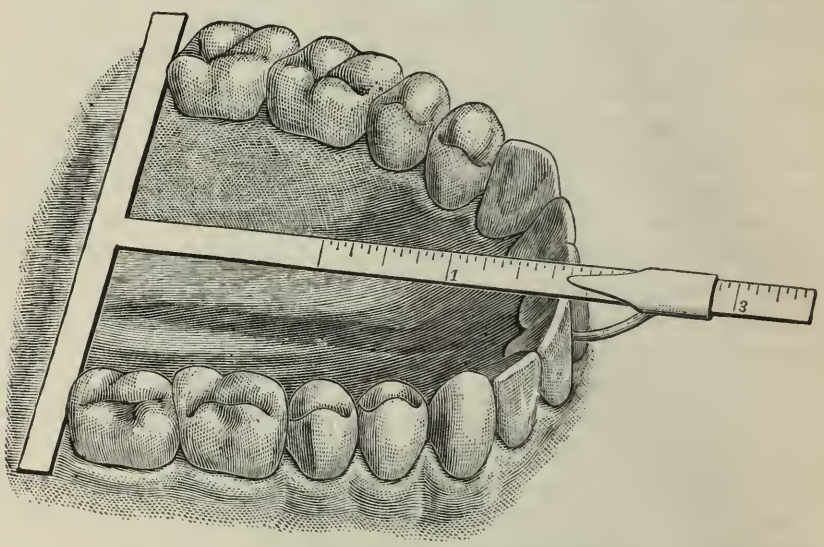
Antero-Posterior Diameter.

The antero-posterior diameter was taken from the alveolar process at a point between the central incisors extending backward in the median line and meeting a line drawn at right angles to the posterior surface of the third molar, as illustrated in Fig. 6.

It is a singular fact that the same laws hold good for the development of the antero-posterior diameter that were laid down for the lateral diameter. Although these examinations were made by different persons in different parts of the country, we find that the antero-posterior diameter of the jaw of the female is less than that of the male by from .02 to .24 of an inch. This disparity, as compared with that of the lateral diameters, is a natural one. After the temporary teeth are all in place, the natural development of the jaw is in an antero-posterior direction, and the natural changes that are taking

place in the evolution of the face and jaws consist of a shortening of the antero-posterior diameter. The great range of difference is due to the fact that it is quite common to find in some individuals an entire arrest of development of the posterior part of the body of the jaw. This is always the case when permanent molars have been extracted, thus allowing the third molar to come forward, or when the individual has inherited the large jaw of one parent and the small teeth of the other parent, or when the jaws have become arrested in development from constitutional disease. In comparing the antero-posterior diameter of the jaws of people of one nation with those of another nation, we must take into consideration the character of the skull. In the brachycephalic type of the Chinese we find the broad jaw, and in the dolichocephalic type of the negro, the long jaw. This difference, however, is only applicable to the pure races, and can be noticed only by comparing the external condition of the head or skull with the jaw. If we were to examine two or three thousand plaster

Fig. 6.



casts of the mouths of a mixed class of people, we would be unable to say that this one belonged to a brachycephalic individual and that one belonged to a dolichocephalic individual. The local conditions so modify the shape of the jaw that in the mixed classes there is not that correlation between the shape of the skull and jaw which we find in the pure races. The fact that the jaw develops or lengthens from before backward would naturally impress one with the fact that if the jaws were not exercised by mastication, or if any of the permanent teeth had been extracted, or if a third molar failed to make its appearance, the length required would necessarily be much less than that required by a jaw full of teeth and one that had been well exercised. Therefore nature developed only the posterior part of the jaw, that which is actually necessary, and hence the short lower jaw.

The Third Molar.

I have frequently observed that the crowns of the third molars are not only stunted in their growth, but the structure of the enamel and dentine is of very poor quality, as compared with the other molars in

the same mouth and on the same side. There seems to be a want of proper deposition of calcium salts, as well as a lack of proper crystallization and life-giving properties after they have been deposited. Large fissures and pits are noticed, not only in the sulci, but are very commonly found in other parts of tooth-substance where we would naturally expect to find strong, healthy tooth-structure. The crowns are much smaller, as compared with the other molars on the same side, and are always irregular in shape, sometimes long and sometimes short; frequently they will be serrated or scalloped, and occasionally they have the appearance of two teeth fused together. Harris* says of the third molar that it is "both shorter and smaller than the other molars, and that the roots of the upper are occasionally united, while the lower has usually but one root." Wedl: "The crowns of the wisdom-teeth, especially the upper ones, are most frequently stunted in their growth. Dwarfish growth affects these teeth most frequently and occurs by itself, often unaccompanied by any other deformity." Mr. John Tomes† says, "First molars will be found to be the most constant, and the third molars the least constant, in the number, shape, and position of their roots." Mr. Felix Weiss‡ says that "this tooth varies not only in shape, but also in size." Mr. Chas. S. Tomes§ remarks that among civilized races it is almost exceptional for the upper wisdom-tooth to be regular in form or position, so that extreme variability prevails among these teeth. It erupts at different periods, but in most cases it appears about the twentieth year.|| But in twenty-five per cent. of the cases it was found to be absent.¶ These statistics were computed from three hundred and twelve cases. Dr. Van Marter,** of Rome, made an examination of the skulls of the Umbrian and Etruscan races, which existed 500 B.C., with the same results.

The influences which are at work upon the teeth of the people of the present day act in the same manner as did environments, customs, and habits in those early days. I am of the opinion that the third molar is later in its eruption than in former years. In accordance with the eruption of the other molars, this tooth should make its appearance at about the eighteenth year. Occasionally this is found to be the case, but it is my experience that in a large majority of cases it does not erupt until after the twenty-fourth year, and frequently not until the twenty-sixth or thirtieth year. This can easily be accounted for, if the germ is present, from the fact that the jaw does not develop sufficiently to allow it to come through into place. This retarded condition is also due to the fact that at the points where all the other teeth are located, soft, spongy bone or alveolar process is found, and absorption of tissue takes place more readily at these points than at the point of eruption of the third molar, which is made up of true bone, which is dense and hard. Frequently, for want of room, it will erupt until it comes in contact with the second molar and then stop, in which case only a small part of the tooth will be presented. On the

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* "Dental Surgery."

† "Pathology of the Teeth."

‡ Proceedings of the Odontological Society of Great Britain, in *Brit. Jour. Dent. Sci.*, vol. xix, page 256.

§ "Dental Anatomy."

|| Wedl; Felix Weiss.

¶ Felix Weiss.

** *Independent Practitioner.*

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upper jaw the crown of the third molar points toward the cheek. This is due to the fact that there is not room enough in the jaw when the tooth erupts. It slides out to the side, guided by the second molar. If there were plenty of room, both upper and lower third molars would erupt without pain, which is rarely ever the case. The pressure upon the jaw, second molars, and soft tissue frequently produces so much pain that the gums require frequent lancing, and occasionally it is necessary to remove the second molar. The roots of these teeth should be separate and distinct, like those of the first and second molars, but we rarely find this to be the case, as they are usually fused together ; and, while there is a separate canal for each root, the roots are virtually one.

I have examined and recorded observations upon 763 persons over twenty-six years of age. Of this number 342 were males and 421 were females ; forty-two per cent. of the males and thirty-eight per cent. of the females possessed no third molars. These questions naturally arise : Were these teeth in the jaw and not able to make their appearance, or were the follicles improperly formed, or were they missing altogether ? These questions are very difficult to answer, and can be decided only in the anatomical room. In this work it matters little whether the germs are present in the jaw or not. The fact that the teeth are not present in their proper places, and that when present they are in many cases crowded out of position for want of room, is proof positive that the jaw is not sufficiently developed to allow them to erupt normally. The fact that there is no space between the second molar and the angle of the jaw after the twenty-sixth year, as is found in the lower animals between the third molar and the angle of the jaw, is also proof that Nature has made no provision for the eruption of the third molar.

That the wisdom-tooth will eventually disappear among future generations, is maintained by many writers. Professor Wortman, in an article entitled "The Negro's Anthropological Position," published in the *Analostan Magazine* and abstracted in the DENTAL COSMOS, vol. xxxiii, p. 228, says, "In the white man the shortening of the face and consequent reduction of the facial skeleton has materially affected the dental arch. To such an extent is this true that it is almost the exception nowadays to find a perfectly well-formed arch with a normal set of teeth. The teeth that have been most affected by this change are the last molars, which may be truly said to be in an advanced stage of disappearance, and at no very distant period the European skull will be further characterized by the absence of the third molar. When it is developed it is always smaller than the other molars, the roots are connate or grown together, and it is so lacking in vitality as to be subject to rapid decay, frequently necessitating early removal." I quote from Brunton :* "In nearly all the black people the wisdom-teeth are generally furnished with three fangs and are sound, while among the whites they have only two fangs and decay early. Most ancient jaws exhumed in Europe present the former character." Richard Owen † says that the wisdom-tooth is sometimes not developed. Darwin :‡ "Formerly the wisdom-teeth of the upper jaw possessed not only three fangs, but also in some cases four, five,

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* "Races and People." † "Odontography." ‡ "Descent of Man."

and six. Now, among the American races, in both the upper and the lower jaw the roots of the wisdom-teeth are fused together."

That the wisdom-tooth grows smaller as we ascend the scale of civilization is upheld by many writers. But even in the lower races, although the wisdom-tooth does not present the variations that are found in more civilized races, we find that it is far inferior to the teeth of the ape and chimpanzee, although among these animals we find the first indication of the step toward the degradation and subsequent disappearance of this tooth.*

But the tooth in all these cases is as serviceable as the other molars. Among some of the monkey tribes the third molar is of equal size to the first and second, while again in others it is larger and in some others is smaller.†

Mr. Darwin maintains that these teeth are rather larger than the other two molars in the orang and chimpanzee.‡

Mr. C. S. Tomes says,§ "In Macaques the third molar is larger than the first two, and is quinquicuspid below; the upper quadricuspid. It is generally said that in man the molars decrease in size from before backward; that the first molar is largest, while in the anthropoid apes the contrary is the case. This is true on the whole, but requires some qualification, as in the Australian the second and third molars are not smaller than the first, and of the chimpanzee the same thing may be said to be true. In the anthropoid apes the wisdom-tooth is nearly or quite as large as the other molars, and shows no variability, while it comes into place almost simultaneously with the canine. In the higher apes, such as the gorilla, the third molar is in every respect a well-developed tooth, sometimes even larger than the first or second molar, but instead of a spongy, softened crown it has a crown on which the cusps are arranged according to the typical pattern." He also says|| that "the wisdom-tooth (in lower races) has ample space to range with the other teeth, and is a characteristic molar. In the lower races of mankind the wisdom-tooth appears to vary but little, is of large size, and is never misplaced. In the more civilized races it is quite exceptional for the lower wisdom-tooth to have the four cusps distinctly developed. This is one of the things which pointed to its disappearance." Mr. Mummery says, "Among the stronger African tribes the third molar was always present in the lower jaw, but in the enfeebled races it was frequently absent." Professor Allen describes the third and fourth molars of an Australian skull, which show a tendency to the bicuspidate type.¶ But still more marked differences are found between the savage and civilized races than between the savage races and animals. In civilized man the degraded condition of this tooth in its degeneracy and imperfection is very great, as compared with the nearly perfect condition of the same organ in the lower primates.**

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* Thompson, "Care of the Wisdom-Tooth," etc.
† Professor Owen.
‡ "Descent of Man."
§ "Dental Anatomy."
|| Proceedings of the Odont. Society of Great Britain.
¶ Dental Cosmos.
** Thompson, "Care of the Wisdom-Tooth," etc.

Height of Vault.

The height of the vault in most cases is far below the average of the present day. In 4614 measurements* of normal individuals, made by the author, it was found that the average height of the arch was .58 of an inch; the measurement was made from the alveolar border between the second bicuspid and the first permanent molar to the height of the arch. Fig. 7 illustrates an instrument invented by me for the purpose of measuring these cases; it also shows the position of the instrument upon the model when the measurement is made. The theory advanced by me in a former paper was that the more intelligent the race of people in a section of the country, the higher the vault. That is to say, the more highly developed the brain, the more prominent the frontal and parietal bones and the higher the vault. The lower these bones are, when in a normal condition, the lower the vault is found. In most of the uncivilized races we find the jaw well developed, but the vault low; while, upon the other hand, the jaws of the intellectual people are narrow and the vault is high. I do not wish to be understood as saying that low vaults are never observed with high foreheads, or high vaults with low foreheads, because we do sometimes find this to be the case, although it is very rare.

Fig. 7.

On the other hand, the high vault is not always indicative of a developed brain, or a low vault of an ignorant individual. In a general

*See article, "Mouth Breathing not the Cause of Contracted Jaws and High Vaults," Dental Cosmos, November, 1891.

way, if we enter a church and look up at the ceiling we know whether the roof is dome-like or flat; we judge whether the outside of the roof corresponds to the inside. So with the vault and outside or cranium,—if the vault is high, the cranium will be high, etc.

The shape of the vault, however, like the shape of the cranium, does not indicate the intelligence of the individual. Thus by glancing at the table we will observe that the ancient Peruvians and the Sandwich Islanders have the highest vaults, although one of the lowest vaults is also found in the mouth of an ancient Peruvian. I think I am safe in the assertion that the high vault indicates a neurotic condition inherited from the parents.

Having studied the measurements of the jaws of crania as well as of living individuals, and noticed the changes that are taking place, let us now study the causes that are producing these changes.

Changes of Structure due to Change of Climate and Soil.

In crossing between different races, says Quatrefages, the half-breeds possess the character that in each of them predominates over the corresponding characters of the other. Races of men most diverse in physical organization, such as blacks and whites, do not amalgamate perfectly, but obey the laws of hybridity.*

M. Jacquinot lays down the following conclusions on hybridity :† It is impossible, no matter how we produce crosses between species or races in the globe, to obtain a product which represents exactly one of the primitive types; that is to say, we shall never be able to construct with all the pieces a Negro, an American Indian, a German, or a Celt. Species will separate from primitive types and will become the more altered by crosses with other species, in proportion as the individuals which compose it differ from one another and the types are more numerous. Mulattoes are more degenerated than either negroes or whites, except in intelligence, in which they are intermediate.

The hybrids present in the average a mixture of the physical and mental character of the parents.‡ Gallesio§ impregnated an orange with pollen from a lemon, and the fruit borne on the mother-tree had a raised stripe of peel like that of a lemon both in color and taste, but the pulp was like that of an orange.

It is well known that plants undergo metamorphoses when transferred from one soil to another. Human races also change when transported from one country to another. In the United States, the Irish immigrant loses his Celtic aspect and becomes Americanized. This is also true of the Germans. There is no escape from the conclusion that physical and social conditions have here great modification of functions and structure, which offspring have inherited and increased.||

I have in many instances observed in the case of individuals whose complexion and general appearance have been modified by residence in a hot climate, that children born to them subsequently to such

* Nott and Gliddon.
† Ibid.
‡ Vogt, "Lectures on Man."
§ Darwin: [illegible]
|| Herbert Spencer; "Principles of Biology."

residence have resembled them rather in their acquired than primary mien.*

Sageret and Naudin found that the cucumber could not be crossed with any other species of the genus; yet we hear from Naudin ("Flore des Serres") that there is a race of melons in which the fruit is so like that of the cucumber, both externally and internally, that it is hardly possible to distinguish the one from the other except by the leaves.†

From the effects of crossing and variation, Mr. Rivers enthusiastically anticipates that the day will come when all our roses, even moss roses, will have evergreen foliage, brilliant and fragrant flowers, and the habit of blooming from June till November.‡ The effect of climate upon the organisms has been written about to a great extent, and opinions are widely different. That it modifies vegetable life has been shown. Hemlock is said not to yield conicine when planted in Scotland. The root of Aconitum napellus becomes innocuous when planted in a frigid climate. Laurus sassafras in Europe loses the odor proper to it in North America. Annual plants sometimes become perennial when changed to a new climate.§ The tobacco-plant changes its form and a different grade of tobacco is produced when transplanted from North Carolina to Wisconsin.

Wheat quickly assumes new habits of life.|| The peach has become hardier since it was known two thousand years ago. The blotched varieties of heartsease do not acquire their proper character until hot weather sets in, while other varieties lose their beautiful marks as soon as this occurs. The nature of the season has an especial influence on certain varieties of dahlias. The variegated strawberry loses its character when transferred from a dryish soil to a fresh and humid one. Dryness seems generally to produce hairiness of plants.¶ The Egyptian goose first laid its eggs in December when brought to France in 1801. In 1844, the eggs were laid in February; in 1845, in March; in 1846, in April, the time when our common goose lays. French vines, when moved to the island of Bourbon, yield constantly, and silk-worms have acted in a similar manner; they have laid their eggs and spun their cocoons with perfect indifference to the season of the year.** When the new conditions of existence have differed too widely from old ones, local races have been formed, and thus, though perhaps assisted by human industry, pigs with fleece are to be found on the cold plateaus of the Cordilleras, sheep with hair in the warm valley of the Madeline, and hairless cattle in the burning plains of Magenta.††

Climate modifies the form of dogs. Several English breeds cannot live in India, and when bred there degenerate physically and mentally. Muzzles of bull-dogs become finer, and they lose their underhung character. Horses become reduced in size and attenuated in appearance when living on mountains, probably due to want of nutrition. Puni ponies are different from their Spanish progenitors.‡‡ Great heat decreases growth of fleece of sheep, as those imported into the West Indies and Africa. On the other hand, many wool-bearing sheep live on the hot plains of India. If they are sheared at a proper

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* Dr. Brown, in Cyclopædia of Practical Medicine.
† Darwin.
‡ Ibid.
§ Ibid.
|| Ibid.
¶ Ibid.
** De Quatrefages.
†† Ibid.
‡‡ Darwin and Tylor.

time, all goes well; but if not, the wool detaches itself in flakes, and short hair like that of a goat is produced.* In case of animals there are grounds for believing that cold and damp affect the growth of the hair.

It is a well-known fact that a change of climate and soil effects perhaps almost as great a change in the constitution as would result from an infusion of fresh blood.† Galls are of different colors, some having one face as rosy as the rosiest apple. This difference is due to the light. The apples of Nova Scotia are brighter-colored than English apples.‡

The view that a change of soil is beneficial both to plants and animals under domestication has been maintained from the time of Columella, who wrote after the Christian era.

The "pelones" oxen of South America, a variety of ox having rare and fine hair, are adapted to a particular climate. In hot countries a variety is sometimes produced without any hair. The goat in South America has become more agile and of slighter build, with better-formed head and smaller horns than in Europe.§

Creole pullets whose ancestors have lived for ages in a hot climate have chickens nearly naked, or without down, and this is the case till feathers grow. Chickens of newly-imported breeds are covered with down.‖

The steatopyga of certain sheep in Central Asia disappeared in a few generations when removed from their native country. The Niata cattle serve to illustrate the extent to which modifications of the head can take place. This ox exhibits the modifications of the specific characters similar to those which the bull-dog presents among dogs. This race is already represented in the New World by two sub-races, one of which, that of Buenos Ayres, has preserved the horns, while that of Mexico has lost them.¶ A codfish called the bull-dog codfish produces a similar deformity.**

Cattle have been produced in Paraguay without horns, and having reversed hair.†† The Thibet mastiff and goat, when brought down from the Himalayas to Kashmir, lose their fine wool.‡‡ Karabool sheep lose their peculiar black curled fleeces when removed into any other country.§§ In Angora, not only goats but shepherd dogs and cats have fine fleecy hair, due to the severe winter for its thickness and to the hot summer for its silky luster.‖‖ It has been asserted on good authority that horses kept during several years in the deep coal-mines of Belgium become covered with velvety hair, almost like that on a mole.¶¶ It is claimed that the dogs of the New World have larger, flatter feet than those of the Old World, owing, no doubt, to running on snow.***

The *Pulex penetrans* is able to distinguish the white man fresh from Europe from a white man born there.††† The domestic cats which have been bred in Paraguay for three hundred years differ from Euro-

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* Darwin and Tylor.
† Mr. Carr.
‡ Darwin and Tylor.
§ Prichard.
‖ M. Ronlin.
¶ De Quatrefages and Professor Owen.
** Dr. Wyman.
†† Darwin.
‡‡ Dr. Falconer.
§§ M. Burnes, "Travel in Bokhara."
‖‖ Mr. Ainsworth.
¶¶ Darwin.
*** Sir James Richardson.
††† Humboldt.

pean cats in being smaller by one-fourth, are more lanky, the hair is soft, shiny, scanty, and lies close, especially on the tail.* In another part of South America the introduced cat has lost the power of uttering its nocturnal howl.† On the opposite coast of Africa from Guinea the cats are covered with short, stiff hair. Throughout the Malayan archipelago the cats have truncated tails, often with a sort of knot at the end.‡ In China a breed has developed without ears.§

Humidity of atmosphere, as in the region east of the Bay of Bengal, decreases the stature of horses. In Japan they reacquire their size.‖

The effect of climate upon the human race has been discussed by quite a number of writers, and their conclusions have been variable.¶ The American people are semi-nomadic. Thus the effects of disharmony of climate cannot but act in a depressing manner upon the general system, impairing nutrition and development, and influencing the teeth in a greater or less degree.

Trustworthy travelers, as d'Abbadie, give accounts of countries where the negroes and whites live side by side. In Abyssinia, where they have long lived in contact and intermingled, the Negro type is no longer characterized by either color, features, or hair, but simply by the exaggerated protuberance of the heel. This character in its turn, however, loses its value on the eastern coast of Africa, where the whole Negro tribes have the heel formed like ours.**

Quechu Indians on the lofty plateaus of Peru, from breathing continually a highly rarefied atmosphere, have acquired chests and lungs of extraordinary dimensions. The air-cells are much larger and more numerous. The Agmara, an allied race, carefully measured by Forbes, living at a height of ten thousand to fifteen thousand feet, have relatively shorter limbs and longer trunks. The femur is shorter than the tibia, the humerus than the forearm,—probably a case of compensation. They present other singular points of structure, as a very small projection of the heel. An examination was made of a few pure families descended two generations from those who had been carried to the low eastern plains, and the characteristic peculiarities are still inherited, but in a less marked degree.†† People of the Andes have larger chests and lungs, due to the rarefied air.‡‡ It is undisputed that presence of lime in the water affects the stature. More conscripts are rejected in Paris in soft-water districts on account of imperfect development and stunted growth, and in soft-water towns the mortality is greater.§§

A tribe of Berber Tuaryk, who by their language are evidently of a race similar to the Arabian, have complexion, skin, and hair like negroes, due to long-continued agency of physical cause.‖‖ Arabs who inhabit the valley of the Jordan have flatter features, darker skins, and coarser hair than any other tribes, a peculiarity attributable to the constant and intense heat of the region.¶¶

It is climate more than any other one thing that has tended to make the Aryan of India so different from the Aryan of Persia.***

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* Raengger.
† Ronlin.
‡ "Voyage of the Beagle."
§ Darwin.
‖ "Quadrupedes du Paraguay."
¶ Thompson, "Hornology of Dental Tissue."
** De Quatrefages.
†† Darwin.
‡‡ Tylor, "Anthropology."
§§ Bray, "Anthropology."
‖‖ Prichard.
¶¶ Foster.
*** "Races of the Old World."

A peculiar race of people inhabiting some islands in the Sea of Bengal have black skin, and frizzled hair which is flat on section, in these points resembling negroes ; their skulls are not narrow, but broad and round ; the lips less full ; the nose less wide, and the jaws not so projecting. Anatomists have classed these as the primitive Negro type, and their difference from others of the same illustrates how great an alteration may take place when a race is subjected to different external conditions.* As negroes spread south into the Congo region, they have less full Negro complexion and features. The Bushmen may also be regarded as a modification of the Negro type. The Negro in the United States is a few shades lighter in complexion, and has altered features. The white is less rosy, with darker and more glossy hair, more prominent cheek-bones, and has a massive lower jaw.†

Bodies and limbs become elongated when Europeans settle in America.‡ This is probably due to the dryness of the atmosphere causing more evaporation.§ The stature of the American Indian and the great development of muscular processes on the bones of the limbs are consequences of abundant food, a temperate climate, roving habits in a wild country, and being without beasts of burden.||

While we may read in some books the assertion that the differences in races are not due to the climate, it is claimed that among many thousand negroes who came under his observation, there was no one who could lay claim to the regular Caucasian features with which some travelers have endowed certain Negro people.¶ American families residing in Pennsylvania without intermingling with others, preserve the characteristics of their stock. The Jews have not been changed, but are typical, notwithstanding that they have resided in all parts of the world. The conclusions regarding the Quichuas' lungs becoming larger, due to a more rarefied atmosphere, are unobjectionable, but there is a population along the Arctic Sea in Siberia whose chests are just as large.**

Physically different races, such as Bushmen and Negroids in Africa, show no approximation under the same climate;†† while on the other hand the coast tribes of Terra del Fuego and the forest tribes of Brazil continue to resemble one another in spite of extreme differences of climate and food.‡‡

A French statistician who has been studying the military and other records with a view of determining the height of man at different periods, has reached some wonderful results, says the Philadelphia *Times*. The recorded facts extend over nearly three centuries. It was found that in 1610 the average height of men in Europe was five feet nine inches. In 1790 it was five feet six inches ; in 1820 it was five feet five inches and a fraction. At the present time it is five feet three and three-quarters inches. These figures are given to show that the same people in the same countries are diminishing in height.

Fair races have inhabited North America, and the dark races South America and Mexico. Both have displaced the aborigines, but have

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* Tylor, "Anthropology."
† Ibid., M. Elisée Reclus, Lyell. M. l'Abbé Brasseur.
‡ Darwin, Beard, Harlan, Vogt. ** Vogt.
§ Dr. Beard, Vogt. †† Tylor, "Anthropology." Winchell.
|| Brace, "Races of Mankind." ‡‡ Tylor.
¶ Pruner-Bey, Vogt.

not approximated them in type. We have no more reason to suppose that an Anglo-Saxon will turn into an Indian, than imported cattle into buffaloes. There are many examples of complexion and hair resisting climate for centuries, without the slightest alteration. We know of no authentic instances where radical changes of complexion or hair have been produced.

The Magyar race of Hungary have suffered no changes during their residence of one thousand years in Hungary. In the heterogeneous population of the United States we can trace the ancient European races.*

We are all familiar with the fact that people living in limestone regions in Virginia, Michigan, Kentucky, and California develop larger osseous systems than those who live in other parts. I have frequently observed that young people who live in towns supplied with water from artesian wells develop into large-framed men and women. This is due to the larger quantity of calcium salts taken into the system in the form of food and water. To such an extent are these calcium salts assimilated that people of middle age are known to possess more tartar upon the teeth, gall-stones, stone in the bladder; and if their urine were examined, large quantities of calcium deposit would be found. These abnormal conditions show that more is taken in than can be appropriated, and the system expels the surplus. Another condition which shows the benefits derived from change of soil and climate is in cases of long sicknesses and breaking down of tissues, as noticed in tuberculosis of the lungs; frequently arrest of development takes place in young children as a result of constitutional diseases. These changes, when properly made, are always beneficial. The system, especially the osseous system, takes on a new lease of life, and the individual who would soon pass away lives for many years.

City *versus* Country Life.

It is a well-known and recognized fact that the people of the city are of lower stature, lighter limb, and are more susceptible to the ravages of disease. That mortality is greater and longevity less in the city as compared with the country, is too well understood to need much discussion.† The mortality is two and one-half times greater in the city than in the country.‡

The following table will serve to show the comparative mortality in large cities, smaller cities, and country.§

Mortality of country is 1 : 35, 1 : 40, 1 : 50, even up to 1 : 100.
" " small cities, 1 : 25, 1 : 28.
" " large " 1 : 24, 1 : 20.

Mortality of city to country is 1 : 12.‖

Fatality of disease is also much higher in city as compared with country life.¶

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* Nott and Gliddon.

† Mr. Stockton-Hough, "Relative Influence of City and Country Life."

‡ Professor Donaldson; Sussmilch; Drs. Jarvis, Farr, Berg, Herz, and many others.

§ Sussmilch.

‖ Graunt.

¶ Mr. Stockton-Hough, Ibid.

Diseases of lungs are twice as fatal in city as in country.
" " digestive system, 2½ times as fatal in city as in country.
" " nervous " 5½ " " " " " "
Epidemics are fourfold as fatal.
Convulsions are tenfold as fatal.

It has been said that a family living continuously in London, and intermarrying with families who have resided in London constantly, would die out in three generations. Again, a family living in London for two hundred years and marrying among people not less old, would become extinct within the two hundred years.*

If all the people of the world lived in cities, the human race would become extinct in two and one-half centuries ;† in all probability the mortality would be greater the larger the cities. It has been shown that women attain greater longevity in the city than in the country. In the country the life of women is monotonous ; the brain is used very little, and very little recreation is taken ; the hours of work are very long, from early morning until late at night, thus insufficient sleep does not give the body time to recuperate. Longevity of men is lessened by residence in the city, no doubt due to closer confinement and more hazardous occupation. We also find that dissipation and intemperance are increased.

The greater mortality of cities is due to foul air, constitutional syphilis, and intemperance.‡ To these may be added irregular hours, want of exercise, unhealthful and more hazardous occupations, undue excitement of the nervous system, less pure water, unwholesome food, unhealthful dress, and an overcrowded condition of the people, especially in tenement-houses and flats. We must not forget the fact that country people are continually thronging to the city, and by intermarriage with city people infusing new blood and new life into them. This fact no doubt adds much to lessen the mortality of the city.

That the quantity of oxygen is sensibly diminished in the air of large cities, even in the open street, cannot be denied.§ The large number of people congregated in a small area, together with the artificial means, if we may so call it, of using up oxygen by means of increased fires and light, would naturally reduce the oxygen in the air and increase the carbon dioxide ; add to this the fact that vegetation is utterly wanting, which is the chief factor in using up the superfluous carbon dioxide and supplying us with free oxygen. The amount of sunlight is also diminished. Now, when these two conditions exist, we would naturally expect to find lessened physical development. " Light is the very life-blood of nature, without which everything in nature would perish utterly."‖ When blood passing from the lungs, where it does not obtain a supply of oxygen, carries to the brain and other tissues and organs carbon dioxide, the consequence of an arrest in the changes necessary to life and growth would result.¶ The effects of carbon dioxide poisoning are far-reaching. Through the brain it

* Mr. James Cantile. J. Milner Fothergill.
† " Relative Influence of City and Country Life."
‡ Dr. Morgan.
§ Professor Wilson.
‖ Sir David Brewster.
¶ Dr. Bell, " Perils of School-room."

affects all tissues of the body. Lack of pure air and of bracing air creates a distaste for exercise; active exercise, but exercise not carried to excess, keeps up the equilibrium between waste and repair.* Another cause of the lack of exercise is the facility with which different parts of the city may be easily reached by means of street-cars, cabs, busses, etc. Then, also, we find that people in the city are more hampered by dress than those in the country, which is a cause for deficiency of exercise. We also find in the city a lack of suitable places for exercise. Now, since deficiency of exercise exists among city people, we would naturally expect to find deficiency of physical development, which is the case. The city-born criminal is found to be inferior physically to the country-bred.† Biologically, man is a fresh-air animal;‡ exercise in fresh air increases the activity of all organs of the body. Muscular activity demands activity of the circulation to keep up the equilibrium of waste and repair. Muscular activity creates increased activity of all the eliminating organs, to rid the body of the products of the disintegration of molecular activity of muscles. The circulation being increased, the respiratory system is increased to meet the greater demands for oxygen. This brings about a vigorous action of all the organs of the body, and, being a physiological process, if kept within physiological bounds no harm but good can result. This course of living was carried out in the patriarchal age. There was moderate activity of all the organs of the body; there was repose to the nervous system; the appetite was normal, digestion was healthy, and there was exemption from local causes of disease. No other causes of death occurred, save those arising from accidents and old age.§

The converse of muscular activity producing well-developed physical condition must be true; *i.e.*, lack of exercise will cause lessened physical development.‖ Animals which for generations back have taken little exercise have their lungs of smaller size, which moderates the form of the bony fabric of the chest, and later affects the form of the body as a whole. With our anciently-domesticated birds, where wings have been little used, their size is somewhat diminished and we find the sternum, coracoids, and scapulæ modified in form.¶ The decrease in the amount of exercise must cause a decrease in the appetite or create an abnormal appetite. The country-bred person therefore eats pastries, meat-pies, and hearty food, and has no difficulty in digesting them. He has plenty of fresh milk, butter, and vegetables; the milk, from the presence of the phosphate salts, heightens stature.** The city person cannot eat meat-pies and pastries at all, therefore he rejects them.†† He finds that he can eat meat; as a consequence he partakes largely of a flesh diet, but his exercise is hardly sufficient to digest this. If he is not strong enough it passes through the alimentary canal undigested, partly decomposed, causing in some cases only

* Dr. Darbishire, "Recreation."
† Dr. Beddoe.
‡ Dr. Darbishire, "Recreation."
§ Dr. Smith, "Limitations and Modifying Conditions of Human Longevity."
‖ Herbert Spencer, "Physical Education."
¶ Mr. Darwin.
** Beddoe.
†† J. Milner Fothergill.

abdominal tenderness, in other cases other evils.* If the digestion is strong enough to digest this food, additional work is thrown upon the liver and kidney. Uric acid is one of the products of the oxidation of flesh food.† It is excreted by the kidneys, and sets up interstitial nephritis. Uric acid is also a cause of gout.

Again, the city-bred person rejects all fats, which are necessary to healthy tissue ; he rejects them because the greater part of his life is spent in an overheated room. People who live among the Esquimaux soon acquire a relish for whale-blubber and all the fats and oil they can obtain.‡ This lessened use of fats, and diminished oxygen and sunlight, are the great causes of pulmonary consumption, which claims twenty-five per cent. greater mortality in the city than in the country.§ Deficiency of breast-milk in mothers is a cause of stunted growth,‖ and want of good cow's milk is also a cause. Early and copious use of alcohol, and intemperance ; want of opportunity and stimulus for the development of their physical powers by young persons in town, the earlier occurrence of puberty,¶ and greater frequency of youthful profligacy** are among the etiological factors of stunted growth. The crowding of people in tenements, where breathing of effluvia over and over occurs, also the crowding together of pauper population in cellars and underground rooms, must act as fruitful causes of deformities and disease. These houses are often erected on land made of sweepings of streets, where the streets are narrow and filthy. The sewerage is often inadequate to the demands, and the contents of cess-pools surcharge the porous earth.†† Wherever such conditions are met with, sickness must prevail, and thus all physiological processes, growth, and development will become perverted.

In the city the constant excitement hastens the development of the nervous system, which is the center of the nerve-force supplying all the organs of the body. Unrhythmical, harsh, and jarring sounds cause molecular disturbance of the system. Specialization must have a baneful effect upon the body. The exclusive concentration of mind and muscle to one mode of action is both negatively and positively pernicious, and more so when accompanied by bad air in overheated and ill-ventilated apartments.‡‡ Close confinement in school-rooms, together with competition, which must necessarily follow from our public school system, must work ravages upon the system, especially the nervous system, of the children, united as it is with the pernicious conditions existing.§§ In addition to the school duties, the city child has usually to pursue the study of music, painting, and the like, from all of which the country child is free. All these must necessarily produce an artificial condition of life, under which condition a degen-

* Dr. C. K. Chambers, "Dietetics."
† Fothergill ; Dr. Chambers.
‡ Darwin.
§ Professor Donaldson.
‖ Beddoe.
¶ Quietelet, "On Man."
** Beddoe.
†† Dr. Clendenin, "General Causes of Disease"; Dr. Jas. Johnson ; Carl Pfeiffer.
‡‡ Dr. Beard, "American Nervousness"
§§ Sir John Sinclair.

erated physique is found and more deaths must occur.* The child is ill equipped to meet the demands of physical life, and therefore it cannot meet the demands made upon the brain and nervous system.

Population tends to concentrate more and more in dense masses. In some of our older states from fifty to seventy-five per cent. of the whole population live in cities numbering eight thousand or more. Registration reports of Massachusetts, which have now been published for forty-seven years, show that in thirty years—from 1850 to 1880—the average age of all persons who died in Suffolk, in which Boston is included, was twenty-three and one-third years. The corresponding age in Barnstable county, also on the seaboard, was thirty-seven. In Franklin county, an inland rural county, it was thirty-eight and one-half years, while in the island county of Nantucket it was 46.15 years, nearly double that in Suffolk county, thus showing that the uniform higher death-rate is greater in densely-populated counties.†

In the town of Sharon, Norfolk county, Mass., which is the highest point of land in the eastern part of Massachusetts and has a population of about thirteen hundred, the average longevity is sixty-four years.

Results arising from the Union of Different Nationalities.

Mr. C. J. Jones, of Garden City, Kansas, who has produced at least five distinct races of cattle by crossing with the buffalo, says that "each of these races is perfect in every respect. Their flesh is rich and good, and there is a great deal of it. Their milk and butter are of the very best quality, and their fur is glossy, heavy, and warm." A peculiar part of the experiment in crossing developed the fact that the breeding could not be developed with a Galloway bull and a buffalo cow. The crossed animals have a tendency to look like buffalo, rather than like their domestic ancestor, and cases are frequent in Mr. Jones's herd where apparently perfect buffaloes have resulted from the intermingling of the species.‡ The fur comes from the three-fourths and seven-eighths crosses, and even the fifteen-sixteenths cross develops excellent hides. Close confinement deteriorates the health status of a buffalo, showing that these animals will not retain their healthy condition when placed in close confinement. The illustrations are given to show that when different breeds are crossed, the offspring exhibit a change in the osseous system.

Breeders are crossing races every day for some purpose, and they expect a few irregularities more or less marked in the first generation; but they know that the race will soon settle, while the disorder would only increase if the crossing had taken place between species.§

When Dorking fowls with five toes are crossed with other breeds, the chickens often have five toes on one foot and four on the other. Some crossed pigs raised by Sir R. Heron between the solid-hoofed and common pig had not all four feet in an intermediate condition, but two feet were furnished with properly divided and two with united hoofs.‖

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* Dr. Price.

† President C. W. Eliot, "Family Stocks in Democracy."

‡ *Chicago Tribune*, January 20, 1891.

§ Quatrefages.

‖ Darwin.

Heterogeneous races have by intermixture given rise to raceless masses, people which present no fixed characters, and who form, so to speak, dispersive circles around the original species, which at their points of contact become confluent.*

Pure races exhibit a more uniform type, and the mixed races a variegated type, and this variation increases as the intermixture increases.†

When we hear of a people which, despite a low state of intellectual culture, exhibits a variety in features, nose, lips, as for instance among the Tschuvashes, we shall not be wrong in considering it as of mixed origin.

The Samboes, descended from an Indian and Negro, in the south of the United States, present sometimes crisp hair with copper-colored skin, and all other Indian characteristics, and sometimes the coarse hair of the Indian upon the head of the Negro, with a black skin. There is here no intermediate type produced by intermixture, but there is produced an irregular agglomeration of the characteristics of the parent forms.‡ It might be demonstrated that these different races, the people of Northern Italy, Southern Germany, Great Britain, not to speak of the United States, where the fusion of blood is probably inexplicable, have given birth, by their intermixture, to ethnological modifications still recognizable. In all these countries the instability of anthropological characters is in contrast with the fixity which marks pure races.§

The union of different nationalities is more common in this country than in any other ; due, no doubt, to the fact that people of all countries and nationalities flock here to better their condition in life. We would expect that marriages would naturally result from a commingling of these foreign elements, especially in the newer parts of the country. Immigration of different nationalities, and intermarriages which take place, tend to improve the race physically in some respects, and in others degeneracy results. Inasmuch as the tendency in this country is toward the production of small jaws, while the jaws of foreigners are much larger, the offspring of such marriages would naturally inherit the extreme peculiar characteristics of both parents. Such peculiarities are very noticeable in the tribe of Marshpee Indians on Cape Cod. The present people are descendants of the original Indians, who married among the whites, negroes, and Portuguese. These intermarriages have continued down to the present generation, making seven or eight generations in all, until, as Professor Putnam, of Harvard College, has said, "there is very little Indian blood left." There are, however, three or four of the older people who still retain all the characteristics of the early Indian race. It is very interesting to observe the peculiar features of the younger generation, a few of which I will describe. A little girl, eight or ten years of age, presented all the peculiarities of the Negro,—broad nose, thick lips, dark skin, with the long, straight, black hair of the Indian, reaching nearly to her waist. Another, Mrs. H., whose mother is half white, father Negro ; she is full Negro in appearance, except the skin, which is copper-colored. The jaws are slender in outline, and quite unlike the

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* Vogt.

† Waitz, "Anthropology."

‡ Ibid. ; Forey on Schoolcraft.

§ Broca, "Hybridity in Genus Homo."

father's. Mr. K., great-grandfather, Negro ; mother, Indian ; father, three-fourths Indian. He has large jaws like the Negro ; long, straight hair, copper-colored skin, high cheek-bones. Mr. P., maternal grandfather, Portuguese ; paternal grandfather, Negro ; paternal grandmother, Indian and white ; maternal grandmother, Indian and Negro. He has fine curly short hair, Negro nose, high cheek-bones, large jaws and teeth, upper and lower teeth occlude. I could give from my note-book many other illustrations of these marked changes in bone-structure and also peculiar mixtures produced by the union of different nationalities, but enough has been said in regard to this tribe to show that when there is a union of different nationalities, the offspring inherit not only the peculiarity of one parent, but frequently possess a mixture of the peculiarities of both. A similar class of people made up of a union of Indians and Negroes is located in South Carolina, and called by the people "Red Bones." They have been thus described in an interview with Senator Hampton : "They live in small settlements at the foot of the mountains, and associate with none but those of their own race. They resemble in appearance the gypsies, but their complexion is red. This intermixture, which is common in the Carolinas, produces marvelous results. It takes the kink out of the hair of the African, strengthens his features, and improves him in every way except in temper."

These inherited peculiarities do not cease at the first generation, but are transmitted to at least the seventh or eighth generation, as I have shown in the cases of the Marshpee Indians. It would seem that, from these cases, race peculiarities under favorable circumstances might be carried on indefinitely. There is a tendency on the part of these Indians, due no doubt partly to the mixture of white blood and partly to the soil, climate, and environment, to take on the general make-up, as regards the osseous system, of the native white people. So far as my investigations went, I was unable to observe the high vault, irregularity of the teeth, and the neurotic condition so noticeable among the native white people. While they possess the same facilities for schooling, they lead a very quiet life of farming, fishing, and out-door work generally. The trades, professions, and such lines of work are not sought after, and hence neurotic conditions are not found.

The improvement of the "Red Bones" over the Negro by "straightening his features," mentioned by Senator Hampton, must necessarily consist of a change in the bones of the face. These changes must be brought about by the union of the Negro with the Indian, producing children not unlike those already mentioned in connection with the descendants of the Marshpee Indians. Americans are all familiar with the changes that have taken place in the features of the Negro, due to their consorting with the whites. The lower jaw of the children diminishes in size from generation to generation, and the anterior lobes of the brain increase posteriorly, the vertical portion of the frontal bone assuming more of a right angle with the horizontal portion. In this manner the Octoroon and Quadroon possess in many cases beautiful features.

Consanguinity in its Relations to Deformities in General.

There are localities in Europe where intermarriages produce constantly individuals defective in constitution, mind, and limbs.*

The incestuous practice of marrying within the near propinquity had long existed in Spain, with its normal consequences,—dwarfing of the body, and mental degeneration.†

Writers on lunacy attribute lunacy, or innate idiocy, so frequent among Scotch families, to the old national practice of never marrying out of their clan.‡ The most degraded people in Portugal marry within themselves, and each generation is more degraded, which is also true in other countries of Europe.

In a county in South Carolina where the different families intermarry for many generations, the proportion of idiots and deformed is unprecedented.§ Mr. Tylor|| has shown that among widely different races in the most distant quarters of the world marriages between relations—even between distant relations—have been strictly forbidden. He is inclined to attribute this to the evil effects of consanguineous marriages having been observed.¶

Interbreeding among animals is much closer than with the human race. All breeders have testified to the deterioration which arises when too close breeding is carried out among animals.

Consanguinity in itself counts for nothing, but acts from related organisms having like constitutions, and being exposed in most cases to similar conditions. Many physiologists attribute the evil exclusively to the combination and consequent increase of morbid tendencies common to both parents ; and that this is an active source of mischief there can be no doubt.

The short-horn cattle offer the most striking case of close interbreeding. A high authority** asserts that many more calves are born cripples from short-horns than from other and less closely interbred races of cattle.†† Even in an unenclosed country like Paraguay, where there cannot be such close interbreeding, there is an occasional introduction of animals from distant localities, to prevent degeneration in size and diminution of fertility.‡‡

In regard to deer, as observed in the parks of England, Mr. Shirley concludes that in some parks, where there has been no introduction of fresh blood, the constant breeding in-and-in is sure to tell to the disadvantage of the whole herd.§§

The offspring of strong spaniels degenerate into weak and diminutive lap-dogs, when bred in-and-in. In the case of pigs, long-continued and close interbreeding does not affect the external form or merit of the young ; but with many of them the general constitution

* Smith.
† Sir W. Scott, "History of Napoleon Bonaparte."
‡ Percy Hunter.
§ Nott & Gliddon.
|| "Early History of Man."
¶ Darwin.
** Mr. Wright, *Journal of Royal Agricult. Soc.*
†† Darwin.
‡‡ Azara, "Quadrupedes du Paraguay."
§§ Mr. Seebright.

and mental powers were seriously affected ; in some cases idiots were produced.*

. That consanguineous marriages have a very demoralizing effect upon posterity, is a well-known fact to all scientists and physicians. The results are very marked in the nobility of Europe. The mental wrecks as well as the physical condition of many of these royal heads are illustrations of intermarriage among near relatives. It is claimed by dentists that excessive or arrested development and irregularities of the teeth are more common among royalty than among the masses. It is very common to find children born of cousins and near relations in this country defective in body and limb. When the brain is involved, we have two factors which assist in producing excessive or arrested development of the jaws. First, direct inherited tendencies, such as a large or small jaw ; and second, defective development due to neurosis. These deformities are very marked among the Hebrews, with whom intermarriages are very common. Thus, in the Hebrew Orphan Asylum, New York city, only seventy-four per cent. of the inmates had normal jaws.†

Inherited Condition.

Some naturalists seem to entertain a vague belief that the law of heredity applies only to *main* characters of structure, not to *details ;* or at any rate that though it applies to such details as constitute difference of species, it does not apply to species. The circumstance that the tendency to repetition is in a slight degree qualified by the tendency to variation (which is but an indirect result of the tendency to repetition), leads some to doubt whether heredity is unlimited.

First in order of importance comes the fact that not only are there uniformly transmitted from an organism to its offspring those traits of structure which distinguish the class, order, genus, and species, but also those which distinguish the variety. This is illustrated by the fact that a certain variety of apples is grown only on that variety of apple-tree,—a certain kind of dogs produces only that variety of dogs. Illustrations of heredity are divisible into two classes. In one class come cases where congenital peculiarities are bequeathed to offspring. In the other class come cases where the peculiarities thus bequeathed are not congenital, but have resulted from changes of function during the lives of individuals. Breeders of animals believe that minor as well as major characteristics of organisms are inherited, as cases of inherited polydactylism and deficient phalanges. Also defective eyes and other defective organs of sense, peculiarities of skin and hair, are transmitted, as also are an entire absence of teeth or of particular teeth, or anomalous arrangement of teeth. General nervousness, or a bias toward suicide, are also inherited.

Functional disorders artificially established may be conveyed to offspring. Brown-Sequard demonstrated this in the case of guinea-pigs.

Some may infer that offspring may differ somewhat from each other and from both parents, yet that in everyone of them there must result a homogeneous mixture of the traits of the two parents. A little consideration shows that the reverse is inferable. If throughout the pro-

* Darwin and Mr. Wright. † Talbot, "Irregularities of the Teeth."

cess of development the physiological units derived from each parent preserved the same ratio to each other in all parts of the growing organisms, each organ would show as much as any other the influence of either parent. But we know that no such uniform distribution is possible. It has been shown that in any mixed aggregate of units segregation must go on. Incident forces will tend ever to cause separation of the two orders of units from each other, will integrate groups of the one order in one place, and groups of the other order in another place. Hence there must arise not a homogeneous mean between the two parents, but a mixture of organs, some of which mainly follow one parent, and some the other, and this is the kind of mixture observation shows.* This is shown in cases where a child inherits the small jaw of the mother and the large teeth of the father, or *vice versa*.

We seem to inherit, bit by bit, this element from one progenitor, that from another.†

When a new character arises, it tends to be inherited at least in a temporary and sometimes in a most persistent manner. We may, on the whole, conclude that inheritance is the rule, non-inheritance the anomaly. In some instances a character is not inherited, from the conditions of life being directly opposed to its development.

All races presenting any remarkable peculiarity, such as solid-hoofed swine, Mauchamp sheep, Niata cattle, etc., are instances of the long-continued inheritance of rare derivations of structure. With gout, fifty per cent. of the cases in hospital practice are inherited, and a greater percentage in private families.‡ The unanimity of the belief by veterinarians of all nations in the transmission of various morbid tendencies is surprising.§

All scientists have acknowledged the law of inheritance, so that it is unnecessary here to quote from writers who have touched upon this subject, nor does it seem necessary to bring forward illustrations; but we would like to say here that it does not seem too much to assert that neuroses which are distinctly hereditable are in a large measure due to abnormalities in the conformation of the cranium and jaws as well. With regard to the inheritance of mutilated structures no definite conclusion has been reached. Godron denies that mutilations have been inherited. He says that different races of men have knocked out their upper incisors, cut off joints of fingers, made holes of immense size through lobes of ears or nostrils, tattooed themselves, made deep gashes in various parts of their bodies, and there is no reason to suppose that these mutilations have been inherited.‖ However, sometimes a child is born to Sioux Indians bearing these marks.¶ Pitting of smallpox is never inherited, but the author knows of three instances where scars have been inherited. Exostoses on legs of horses, caused by too much walking on hard roads, are inherited.** A soldier, fifteen years before marriage, lost his eye from purulent ophthalmia, and his two sons were microphthalmic on the same side.†† A cow lost a horn from an accident, with consequent suppuration, and she produced three calves which were hornless on

* Herbert Spencer, "Principles of Biology."
† Francis Galton, "Natural Inheritance."
‡ Dr. Garrod.
§ Darwin.
‖ Ibid.
¶ Dr. Wetherell.
** Dr. Lucas.
†† Mr. Sedgwick.

the same side of the head.* A man had the little finger of his right hand almost cut off, and as a consequence it grew crooked. His sons had the same finger of the same hand similarly affected.† Two men, one of whom had his knee and the other his cheek severely cut, had children born with exactly the same spots marked or scarred.‡

Under the old excise laws the shepherd dog was exempt from tax when without a tail, and it was therefore removed; and there still exist breeds of the shepherd dog which are always born without tails.

A man had drooping eyelids that were not congenital, but began to droop while he was an infant suffering from fits. Two of his three children are similarly affected. In all cases in which a parent has had an organ injured on one side, and two or more of the offspring are born with the same organ affected on the same side, the chances against coincidence are almost infinitely great. Even when only a single child is born having exactly the same part of the body affected as that of his injured parent, the chances against coincidence are great.§

The following is a summary of Brown-Sequard's observations on guinea-pigs:

"1. Appearance of epilepsy in animals born of parents having been rendered epileptic by an injury to spinal cord.

"2. Appearance of epilepsy in animals born of parents having been rendered epileptic by section of the sciatic nerve.

"3. A change in the shape of the ear in animals born of parents in which such a change was the effect of a division of the cervical sympathetic nerve.

"4. Partial closure of the eyelids in animals born of parents in which that state of the eyelids had been caused either by the section of the cervical sympathetic nerve, or removal of the superior cervical ganglion.

"5. Exophthalmia in animals born of parents in which an injury to the restiform body had produced that protrusion of the eyeball. This interesting fact I have witnessed a good many times, and I have seen the transmission of the morbid state of the eye continue through four generations. In these animals, modified by heredity, the two eyes generally protruded, although in the parents usually only one showed ophthalmia, the lesion having been made in most cases only on one of the corpora restiformia.

"6. Hæmatoma and dry gangrene of the ears in animals born of parents in which these ear alterations have been caused by injury to the restiform body near the nib of the calamus.

"7. Absence of two toes out of the three of the hind leg, and sometimes the three, in animals whose parents had eaten up their hind-leg toes, which had become anesthetic from a section of the sciatic nerve alone, or of that nerve and also of the crural. Sometimes, instead of complete absence of the toes, only a part of one or two or three were missing in the young, although in the parent not only the toes, but the whole foot was absent (partly eaten off; partly destroyed by inflammation, ulceration, or gangrene).

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* Dr. Lucas.
† Blumenbach.
‡ Prof. Rolleston.
§ Darwin.

"8. Appearance of various morbid states of the skin and hair of the neck and face in animals born of parents having had similar alterations in the same parts, as effects of an injury to the sciatic nerve."

It should be especially observed that Brown-Sequard has bred, during thirty years, many thousand guinea-pigs from animals which had not been operated on, and not one of them manifested an epileptic tendency, nor has he ever seen a guinea-pig without toes which was not the offspring of parents which had gnawed off their own toes, owing to the division of the sciatic nerve. Direct inheritance of an acquired peculiarity is sometimes observable. A puppy was taken from its mother at six weeks of age, who, although never taught to beg (an accomplishment his mother had been taught), spontaneously took to begging for everything he wanted when about seven or eight months of age. He would beg for food, beg to be let out of the room, and one day was found opposite a rabbit-hutch begging for rabbits. Instances are on record, too, of sporting dogs which spontaneously adopted in the field certain modes of behavior which their parents had learned.*

Horses bred on the grazing farms of the Cordilleras are taught a peculiar pace. This pace is inherited by their descendants.†

"The Caribs flattened the foreheads of their children, and the continuance of this practice through successive generations produced a natural flattening of the anterior part of the head, until the Carib infants were born with flat heads."‡

Hippocrates gives an account of the Macrocephalia, a Scythian race believed to have inhabited the Crimea. He says, "There is no other race of men which have their heads in the least resembling theirs. At first, usage was the principal cause of the length of their heads, but now nature co-operates with usage. They think those the most noble who have the longest heads. It is thus with regard to usage. Immediately after the child is born, and while its head is still tender, they fashion the head with their hands, and constrain it to assume a lengthened shape by applying bandages and other suitable contrivances, whereby the spherical form is destroyed, and it is made to increase in length. Thus, at first usage operated, so that this constitution was the result of force; but in the course of time it was formed naturally, so that usage had nothing to do with it."

Dr. Harrison Allen says,§ "Lectures on correlation of structure, on vegetative repetition, on the relation existing between phyllogenetic and teratological processes, could be given, as well as the study of the laws of heredity, especially in attempting to answer the question of the transmittal of acquired characters. The teeth are so responsive to the constitutional peculiarities of the individual that their peculiarities can be seen and readily detected. The method of procuring accurate impressions can be applied, and the plans of preserving the form of teeth can be easily accomplished.

"As is known to the zoölogist, the parts involved in the act of

* Francis Galton, "Natural Inheritance."

† Prichard, "Natural History."

‡ F. M. Goodall, "Remote Effects of Fœtal Brain-Injury in Labor; or, Why We are Right-Handed," from Tyler Smith's Lectures on Obstetrics.

§ "Addresses on Anatomy."

mastication are important in the classification of the mammalia, the slightest departure in the form, number, position, and rate of development of the teeth being for the most part correlated with other variations in the economy, while the shapes of the lower jaw and of those portions of the skull that afford surfaces for attachments of the masticating muscles are of importance. No structures of the body resemble the teeth in the character of their response to morbid impressions ; no other organs are arranged in progressive series ; and no other than these are evolved after birth. Hence the effects of disease and accidents to which the teeth are subjected are sure to be recorded in the shapes of the crowns and roots.

"If the student of heredity were to have placed at his disposal a collection of the casts of the permanent teeth of three generations,—that is to say, of the parent of the subject, the subject himself, and the children of the subject,—and if a clinical history were secured of the diseases and accidents that these persons had incurred, a tenable argument might be established as to the significance of the contrasts or resemblances in the forms of the teeth. Thus, if three generations were expressed by the letters A, B, C, and if B is the subject of an acquired character (let us say from scarlet fever or measles), the new form of structure seen in the second and third molars may be transmitted to C. But in order to prove this it is necessary to know the peculiarities of these teeth in A. Hence the teeth of the ancestors and descendants of the person who exhibits the acquired character must be known. A somewhat similar plan of observation could be made on the teeth of the lower animals. It is strange that those teeth with endless pulps, in which growth is rapid and interference with their relations causes permanent records to be made in malformation, should not have been used in studies of nutrition."

Disuse of the Jaws producing Arrest of Development, Early Decay, and Loss of the Teeth.

In investigating the subject of the effects of disuse of the jaw upon its development, one's attention is naturally directed to the results arising from disuse of any organ of the body, and I will therefore present to the reader some data collected by me upon this exceedingly interesting subject.

The disuse of the jaws as the weapon of attack, evident in the large canines of the male anthropoid apes, exercised an influence in reduction of the size of the jaw itself as well as on the teeth. The Neanderthaloid jaw is a type of jaw from the standpoint of the anthropoid apes, and the few weapons of the Neanderthal types of man indicate that biting, as among rowdies of to-day, played no small part in battle, and particularly in duels for female favor. With the development of weapons of offense this employment of the jaw rapidly fell into disuse. The physiological factors underlying this element are similar to those detailed.*

The chief agents in causing organs to become rudimentary seem to have been disuse at that period of life when the organ is chiefly used (and this is generally during maturity), and also inheritance at a corresponding period of life. The term disuse does not relate merely

* Darwin.

to the lessened action of muscles, but includes a diminished flow of blood to a part or organ, from being subjected to fewer alterations of pressure, or from becoming in any way less habitually active.

Rengger attributes the thin legs and thick arms of the Paraguay Indians to successive generations having passed nearly their whole lives in canoes, with their lower extremities motionless. Other writers have come to a similar conclusion in analogous cases. It is asserted that the hands of English laborers are at birth larger than those of the gentry.*

From the correlation which exists, at least in some cases, between the development of the extremities and of the jaws, it is possible that, in those who do not labor much with their hands and feet, the jaws would be reduced in size from this cause. That they are generally smaller in refined and civilized man than in hard-working men or savages, is certain ; but with savages, as Herbert Spencer has remarked, the greater use of the jaws in chewing coarse, uncooked food would act in a direct manner on the masticatory muscles, and on the bones to which they are attached.†

It is familiar to everyone that watchmakers and engravers are liable to be short-sighted, while men living much out of doors, and especially savages, are generally long-sighted. Short-sight and long-sight tend to be inherited.‡

It is a singular fact that sailors are inferior to landsmen in their mean distance of distinct vision. This is probably due to the fact that the ordinary range of vision in sailors is restricted to the length of the vessel and the height of the mast.§

The inferiority of Europeans, in comparison with savages, in eyesight and in other senses, is no doubt the accumulated and transmitted effect of lessened use during many generations.‖ Europeans who have been brought up and spent their whole lives with the wild Indians do not equal them in the sharpness of their senses. The cavities in the skull for the reception of the several sense-organs are larger in the American aborigines than in Europeans. This probably indicates a corresponding difference in the dimensions of the organs themselves.¶

The Mongolians of the plains of Northern Asia are characterized by great breadth of the skulls across the zygoma. This follows from the highly-developed sense-organs.** In the lower jaw of many pigeons the articular surface is proportionably smaller than in the rock pigeon, and the vertical diameter, more especially of the outer part of the articular surface, is considerably shorter. May not this be accounted for by the lessened use of the jaws, owing to nutritious food having been given during a long period to all highly-improved pigeons ?††

One of the chief factors conducive to arrest of development of the jaws, and one which acts in a threefold ratio, is the want of maxillary exercise. This operates in the following manner : first, by lack of exercise the blood, which nourishes the bones, is not carried to the part ; second, the blood does not carry sufficient material to the teeth,

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* Walker.
† Darwin.
‡ Ibid.
§ B. A. Gould.
‖ Darwin.
¶ Rengger and Blumenbach.
** Prichard.
†† Darwin.

hence the enamel formed is defective, and as a result we have early decay; third, by lack of lateral motion the mechanical development of the alveolar process is wanting. It has been shown that the jaws of to-day are not so large as those of pre-historic races, and that they are steadily growing smaller. The early races lived upon coarse food such as roots, herbs, corn, and uncooked meats. This coarse food required considerable mastication in order to be prepared for the chemical changes which are necessary before assimilation can take place. As a result of use, the muscles of the jaw were dense and hard, and when contraction took place they stood out upon the sides of the head like large cords. The bones were well developed, they were also of dense and hard structure ; the processes for the attachment of muscles were prominent and large, and the teeth were large and set deep in the alveolar process.

These physical conditions are noticeable only in those persons who use their masticatory apparatus a great deal, as tobacco-chewers, and are also seen in public speakers and singers. To such an extent has the art of mastication become obsolete that the food is now swallowed whole, or in a semi-masticated condition. The muscles have become flabby, the jaws more slender, and the processes for the attachments of muscles are almost if not quite obliterated. The difference in the size of the superior and inferior maxillæ is a marked illustration of the result arising from the use and disuse of these bones. It is a singular fact that the greater number of irregularities of the teeth occur upon the upper jaw ; when they are found upon the lower jaw, the irregularities are due to local causes.

The upper jaw is a fixed bone, and the blood-supply is small from a lack of stimulus,—*i.e.*, movement, and hence arrest of development is marked. On the other hand, the lower jaw being movable, more blood flows to the part, which thus becomes much more developed.

As a further illustration of the results arising from the use and disuse of the upper and lower jaws, I desire to direct attention to the following fact. It is known to all dentists that the teeth upon the upper jaw are more subject to decay than those upon the lower jaw, although the environment of the teeth upon the lower jaw, especially the bicuspids and molars, renders them more subject to decay than those upon the upper. Tomes says,* "The different teeth are not equally subject to the attacks of caries. In the first place the upper are more frequently attacked than the lower,—according to Dr. Magitot in the proportion of 3 : 2,—whilst the yet more comprehensive tables of Dr. Hitchcock give the ratio of 1.9 : 1, or very nearly two to one." A disease which is becoming a very common one among our people, and which is in a great measure due to want of proper mastication, is that called "Riggs's disease." The first symptom noticed is a slight redness along the margin of the gums. These afterward become swollen and bleed upon the slightest touch ; then follow inflammation of the peridental membrane, absorption of the alveolar process, and consequent loss of the teeth. To such an extent has this disease become prevalent, that at least ninety-five per cent. of all people over twenty-five years of age are thus more or less afflicted. Twenty-five years ago this disease was not considered of any impor-

* "Dental Surgery," p. 273.

tance by the dentist, due no doubt to its comparatively rare occurrence. To-day it is giving him more trouble than decay of the teeth, because a dentist is frequently called upon by patients who have a partial or full set of natural teeth which are quite loose in the jaw; aside from this they are sound and healthy, and after a certain stage in the development of the disease nothing can be done to save them; while on the other hand, if decay takes place, by constant filling they can be preserved.

These conditions are brought about by a change in the mode of living. Man first began to reduce food by cooking, in order to make it more palatable. Roots, herbs, and grains were more finely divided by mechanical means, and thus the labor of the jaws in mastication was lessened. Since these early beginnings man has studied the art of the preparation of food, and to-day it is prepared in such a manner that in most cases mastication is unnecessary. While these changes in the preparation of the food have taken place, man has been modified not only as regards his sense of taste and appetite, but also in the structure of muscles and jaws. "Surely," says Mr. Carter, in the *British Journal of Dental Science*, in speaking of the jaws and teeth, "some law of God and nature has been outraged to bring upon our children so dire an affliction." To such an extent has the sense of taste and refined appetite become cultivated, that at the present day it requires all the skill that cooks are able to display to produce dishes free from all of the peculiarities presented in the early days of cooking. Thus all coarseness has been removed from food, and by the new processes made possible by mechanical as well as scientific discoveries, cereals are reduced to the finest of flour, while the hulls, which contain the phosphates essential to bone-building and also furnish the material for mechanical grinding by the jaw, are entirely excluded. There seems to be a growing inclination on the part of the human race to use that class of food which requires little if any mastication. This evolution will eventually result in the adoption of new modes of acquiring and preparing food,—viz: the manufacture of foods in the chemical laboratory. Indeed, at the present time many forms of food comprising all the nutritive elements necessary to sustain life for the sick, are being prepared in the laboratory. If these foods prepared in a liquid form are sufficient for the nourishment of children and the sick, it seems reasonable to expect that they will soon become the exclusive food of the laboring class, and indeed of all classes. Such being the case, the art of mastication, which is now at a very low ebb, will then become entirely lost.

I have shown that when the teeth push their way into place they crowd one another laterally. By so doing the dental arch enlarges, and the alveolar process develops and grows about the teeth. The lateral movement of the lower jaw in the act of chewing assists greatly in producing the enlargement. The constant movement of the lower against the upper teeth causes them (in many cases of irregularities) to arrange themselves in their proper places. The teeth of tobacco-chewers are rarely irregular. Thus we see that the result of the proper mastication of food has brought about arrest of development of the jaw, and consequent irregularity of the teeth.

DENTAL COLLEGE
TORONTO

Extraction of the Permanent Teeth.

To my mind there is no one cause that has produced such a baneful influence upon the jaws of the present generation as that of dentistry. The constant extraction of the permanent teeth from one generation to another before the osseous system has been fully developed, is developing a race of individuals with small jaws. In my investigations during the past fifteen years for the cause of irregularities of the teeth, I have become convinced that the jaw-bone proper and the alveolar process are two separate and distinct structures. The manner of their development and their functions are independent of each other, and therefore they should be regarded as separate and distinct bones.

The maxillary bones proper are composed of dense compact tissue, and are so constructed as to resist force. They develop from four centers of ossification and eventually blend into one bone, the superior maxillary bone. This bone depends upon the nerve-centers and blood-supply for its development, and is subject to influences such as hereditary taint, constitutional and local lesions, early or late ossification of cranial bones and sutures, for its size and the position it will occupy in relation to other bones of the cranium. After it has developed it remains throughout life, differing thus, as we shall see, from the alveolar process. On the other hand, the alveolar process is made up of soft, spongy tissue; for its development, shape, and size it depends entirely upon the teeth and not upon the jaw. When the teeth erupt, the alveolar process builds itself up about them. If the teeth are extracted or do not develop, no alveolar process is present. The alveolar process develops and is absorbed twice in the life of an individual, provided the second set has been removed. If a tooth of the first or second set is extracted, no matter from what part of the arch, and all the other teeth remain, the alveolar process will absorb at that particular point.

If a tooth erupts inside or outside of the arch, the alveolar process will assume the shape of the contour of the teeth. If the jaw is arrested in its development and the long diameters of the teeth are greater by from one-fourth to one-third than the circumference of the jaw, then as the teeth erupt and find their way into position by wedging themselves in between each other, the diameters of the teeth being greater than the circumference of the jaw, the alveolar process builds itself up about the teeth and upon the outer surface of the jaw. On the other hand, if from constitutional causes the jaw-bone proper should become excessively developed and the long diameters of the teeth should be considerably smaller than the circumference of the jaw, then in the greater number of cases the teeth will remain close together and the alveolar process will develop among the teeth, but upon the inner aspect of the jaw. It stands to reason, then, that the teeth in their relation to one another are like the staves in a barrel or the stones of an arch; each depends upon its neighbor to hold the barrel or arch together; remove one, and the barrel or arch will collapse. Remove a tooth before the twenty-second year, or before the bones and alveolar process have obtained their growth, and the arch or alveolar process will fail to be developed. It will be seen by this argument that the size which the alveolar process will attain is not due to a physiological development, but to a purely mechanical development.

Up to within ten years ago, if teeth decayed to such an extent that

they could not be filled, the only thing to do was to extract them; this was invariably done to supply their place with artificial ones.

Sixty years ago dentistry was not considered a part of the healing art. Many unprincipled persons who had been engaged as watchmakers, printers, barbers, and the like had taken up the practice of dentistry for the money that was in it. They roamed around the country extracting the natural teeth and inserting artificial ones, claiming for their patients that nice white "store-teeth" were much better than the natural ones, because they did not decay and ache, and therefore the person would not suffer or experience any inconvenience on that account.

To such an extent had this become a fad, that I can remember, when a mere boy in Massachusetts, only thirty years ago, it was a common occurrence for young girls, as soon as the front teeth commenced to decay, to go to a dentist in Boston and have all their teeth, sound as well as decayed, extracted, and come home with a brand-new set of beautiful white "store-teeth." Even at the present day, in all parts of the world, there are still to be seen these same charlatans, ready at all times to destroy parts of the organism which God has given us for the purpose of properly masticating our food.

About thirty years ago dentists began to notice that irregularities of the teeth were becoming more common, and if they did not erupt in a fairly normal manner there would be quite a protrusion of the anterior teeth. This subject was discussed in dental meetings, and a remedy was naturally sought for. After considerable controversy upon this subject, it was thought best to remove the first permanent molars, because, as they were the first teeth of the permanent set to erupt, they were also the first to decay. If these were removed early, sufficient room would then exist for the rest of the permanent teeth to come into their proper place. To such an extent had this fad become universal, that in some communities at the present time dentists are in the habit of removing the sixth-year molars, sound as well as decayed. I am told there are communities in this country where it would be impossible to find a single individual with a first permanent molar.

While traveling in England last summer, I was informed by dentists practicing both in England and on the continent that it was the proper thing to remove these molars for the purpose of preventing irregularities of the teeth, and the students in English dental colleges are taught this method.

In reply to one of my letters inviting a dentist of Glasgow to assist me in making examination of the mouths of his patients, he said, "I am sorry to tell you that I am unable to procure the measurements you desire. It is rare indeed to find the sixth-year molars in the mouths of persons at the age of twenty-five, living in Glasgow, especially of Scotch people, which I presume you desire."

Even in this enlightened age and in this country, where dentistry has developed *par excellence*, an article appeared in one of our dental journals* in which the author says, "It is the purpose to show that experience proves that its (first permanent molar) timely removal redounds to the benefit of the other teeth of the permanent set, and in the large majority of instances to the comfort of those we serve;"

* *International Dental Journal*, 1891.

and again he says, "The jaws of the present generation do not seem to be large enough for the accommodation of thirty-two teeth. Witness the large number of cases of irregularities of the teeth which we see in people of our time, when the jaws have to be widened or enlarged to accommodate the teeth, or when the teeth have to be extracted in order to make room;" and yet the doctor is in my opinion advocating one of the most prolific causes of the production of small jaws,—that of the removal of the first permanent molar,—and is teaching by his influence and article the advocacy of this pernicious habit. Why not advocate the removal of one eye or one ear, because, by so doing, the patient who is liable to become near-sighted or deaf may be able to concentrate sight or hearing into the other organ?

Constitutional Lesions causing an Arrest of Development of the Maxillæ.

The results of constitutional diseases are more marked in the osseous system than in any other part of the human body. Debilitating acute diseases (fevers, the exanthemata, etc.) in children are sometimes followed by sudden overgrowth of bone, which is quite noticeable. This process, affecting the jaw, may account for certain proportions of those cases of measles and pneumonia which are followed by dental irregularities and maxillary deformities.

In some cases, however, the process is a low grade of inflammation, which is followed by atrophy of the jaw, instead of hypertrophy or hyperplasia. The special predilection of these processes for the superior maxilla is on account of its liberal blood and lymphatic supply, and the contiguity of such cavities as the antrum and nasal fossæ, which, in many cases, contribute their quota of irritation.

The question of diathesis enters largely into the etiology of maxillary and dental deformities. The physical characteristics of strumous children demonstrate this fact quite forcibly. The description of this diathesis given by Fothergill is decidedly apt in this connection:

"This diathesis has an imperfectly developed osseous system as one of its characteristics. The bones are small, the shafts slender, the epiphyses enlarged, the hands are often unshapely from this osseous defect, the thorax is small, the forehead is high and prominent, the jaw is small, and the teeth crowded and carious."

Persons of a nervous diathesis have small jaws. Constitutional diseases, such as the exanthemata, syphilis, and phthisis, may affect the jaws in common with the other bony structures; and as the teeth do not vary much in size in different subjects, a relatively small jaw results in such cases. Dr. Florence Hunt informs me that the majority of the Swedish and Norwegian patients of the Cook County Insane Asylum are affected with scrofula and other constitutional diseases, and that post-mortems reveal soft and undeveloped epiphyses not unlike cartilages. Writers on surgery have assigned as some of the causes of non-union of bones after fractures, the so-called scrofulous condition, the existence of any of the exanthemata, or the debility arising from them and syphilis.* The arrest of development of the entire organism following cerebro-spinal meningitis is well known to every one.

Pathologists have maintained that the regenerative process in all

*Erichsen, "Science and Art of Surgery"; Wyeth, "Surgery."

tissues is below par in constitutional diseases; that is, that wounds do not heal so readily in a person the subject of constitutional disease. The development of tissue from an embryonal type to mature tissue is identical with the regenerative process* in the healing of wounds, or, as Senn† calls it, the vegetative process. Therefore the same causes that retard the one process must retard the other.

Following out the theory of Metschnikoff and his followers, we must conclude that the energy of the organism is expended in repelling the advances and barring the further progress of the micro-organisms that are the causes of these constitutional diseases. In consequence of this continuous warfare between the cells and microbes, the tissue-cells that are regenerated do not increase the size of the organ as in normal development. That these constitutional diseases do cause an arrest of development in children is well known to every observant parent. Sometimes this arrest of development will be permanent at the time of the disease, but more often the growth of the child is stopped for one or more years, and frequently development will not go on until the child is taken to another climate. The effect upon the jaws and teeth is very marked. Especially is this the case in the upper jaw. When arrest of development of the teeth takes place, pits and furrows are found upon the enamel. Every specialist of experience is able to determine by these pits and furrows the exact year when arrest of development took place. The well-known Hutchinson's teeth, familiar to every physician and dentist, are well-marked illustrations of arrest of development due to constitutional disease.

Neuroses.

It is a singular fact that there seems to be a fascination for neurotic individuals to seek one another's society. Hence the large number of literary societies which are being formed throughout the country, entertainments and social gatherings at which brilliant men and women are to be found. These individuals not only seek one another's society, but marriages are the rule among them. There seems to be an irresistible force or liking one for the other. As a result of such marriages, children are born who, if they live, in many cases become geniuses or possess unbounded egotism. They may become idiotic, deaf and dumb, blind, or later in life insane, criminals, or drunkards. Dr. Bannister,‡ after citing several instances in which the degenerate intermarried, expresses the opinion that such marriages constitute a potent factor in the perpetuation of neuroses. Similar opinions are expressed by Dr. G. J. Kiernan,§ who has also observed similar cases. He refers the degeneracy of genius to this factor. Genius attracts abnormal females, as light-houses do birds. Dr. Manning|| has found that the peculiar sympathy which the neurotics have for one another often results in marriage. The peculiarities of persons who visit their wives and husbands in insane hospitals are remarkable; and it sometimes happens that the least demonstrably insane member of the family is under care, while the most demonstrably lunatic is at large. Nesbit,¶ from his studies on genius, draws the conclusion that neuropaths seem

* Hamilton, "Pathology." † Senn, "Principles of Surgery."
‡ *American Lancet*, vol. vii.
§ *Neurological Review*, vol. i; *Alienist and Neurologist*, vol. xiii.
|| *Australian Medical Gazette*, 1885. ¶ "Insanity of Genius," page 325.

to be drawn to one another. The most remarkable illustration of this fondness of neurotics for one another is demonstrated in the Keeley Hospital at Dwight, Ill. Here are seen men of all professions, trades, and occupations, mingling together in the most social manner. It will also account for the large number of Bichloride-of-Gold Clubs which are being organized in different parts of the country. This sociability and affection are carried to the extent that in many cases cards are exchanged as tokens of remembrance, and also for the purpose of correspondence.

We have now observed the various influences which are brought to bear upon the present people of the world, producing excessive and arrested development of the osseous system and neuroses of the nervous system. Excessive and arrested development of the osseous system may be a direct inheritance, and the children will possess structures similar to those of one or both parents,—as, for instance, a child inherits an upper jaw from one parent and the lower jaw from the other parent ; or he may inherit the jaws from one parent and the teeth from the other ; or a neurotic brain may be transmitted to him, which presides over the development of the osseous system, and thus we get the excessive or arrested development of the jaw.

Abnormalities of the Jaws and Teeth due to Excessive Development.*

Fig. 8 illustrates excessive development of the upper maxilla. It is a characteristic representation of the Irish jaw. The lower jaw is

Fig. 8.

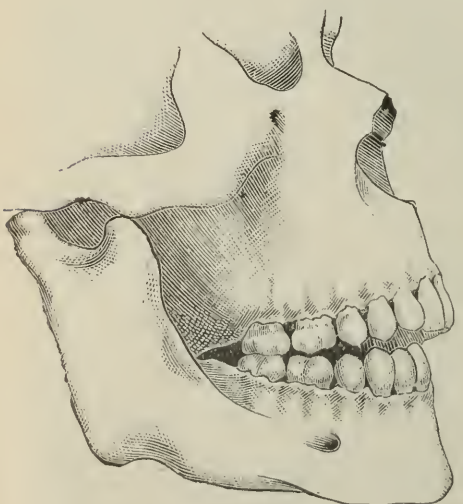
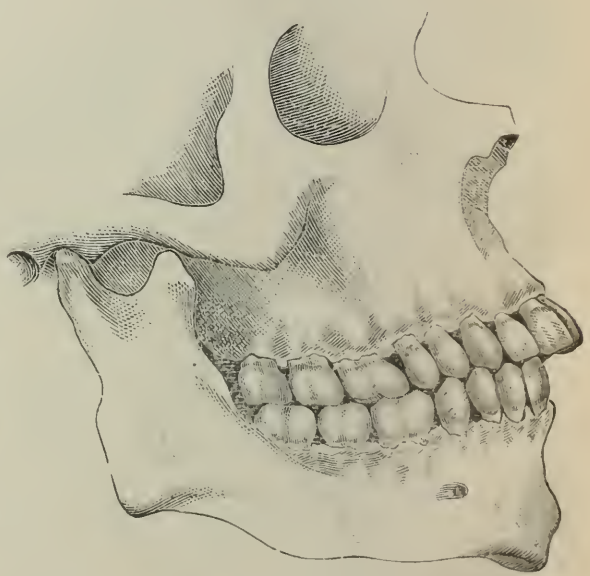


Fig. 9.



normal in size, but owing to the excessively developed upper jaw there is a want of harmony in development, and hence the irregularity of the jaws and teeth. The individual has inherited the upper jaw of

* These illustrations are taken from my work upon "Irregularities of the Teeth."

one parent and the lower jaw of the other parent. The rami are too short for the articulation when the second molars erupt. There is not sufficient space for them to come into position without the jaws opening in front,—a deformity frequently seen.

Fig. 9 illustrates the reverse condition, with different results. The

FIG. 10.

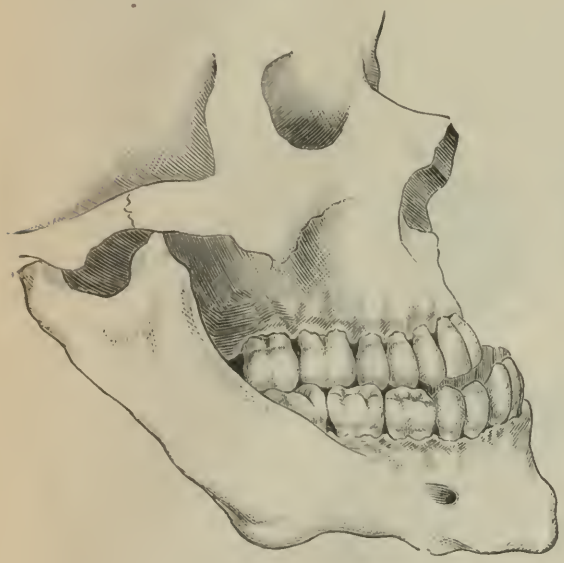
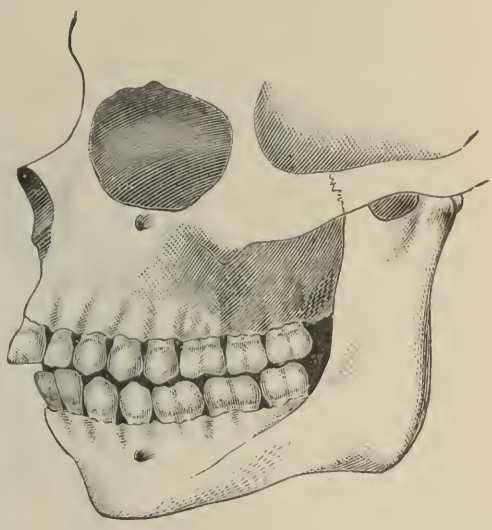


FIG. 11.



patient has inherited a larger body of the lower jaw, but the rami are the same length as in the other case, the upper jaw being very weak, and the force of the lower jaw against the upper has carried the alveolar process and teeth forward, producing pouting of the lips and frequently a protrusion of the upper teeth. I have examined a large

FIG. 12.

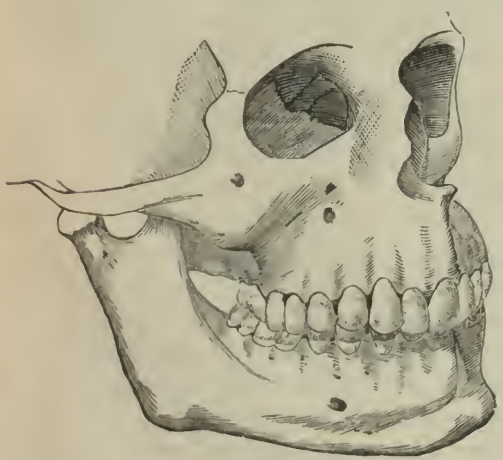
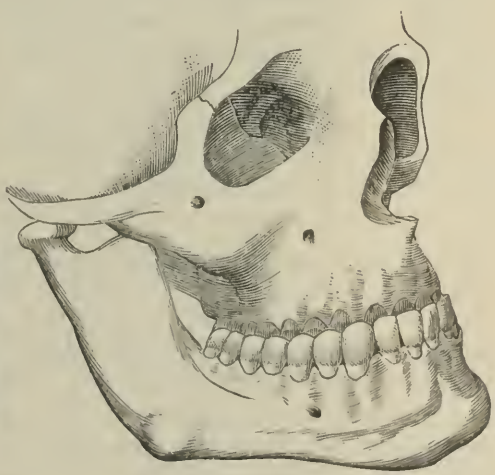


FIG. 13.



number of negro skulls in this country and in Europe, and I am of opinion that this peculiar condition constitutes the marked characteristic of the negro races. The larger lower jaw is a racial inheritance. The weak upper jaw is carried forward, owing to great force as applied by strong muscles.

Fig. 10 illustrates a normal upper jaw and a normal body of the lower jaw. The individual has inherited long rami, which have carried the body and teeth forward, causing a very marked deformity by the protrusion of the chin.

Fig. 11 illustrates a deformity frequently observed upon the streets,—an arrest of development of the body of the lower jaw. These people possess a receding chin, and, in a case of marked arrest of development, no chin at all.

Fig. 14.

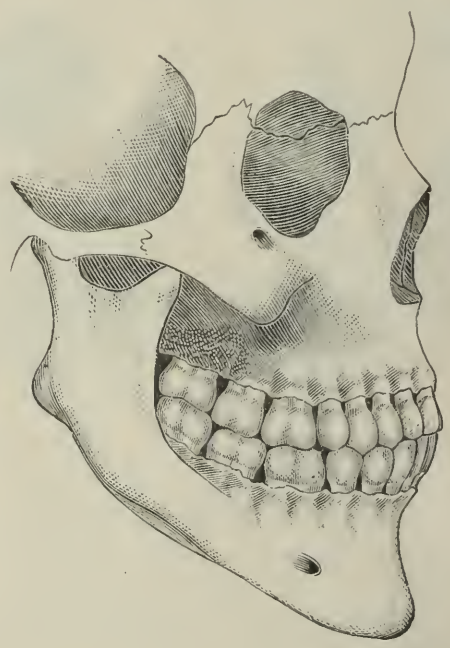


Fig. 12 illustrates a normal lower jaw, but the patient has inherited a larger upper jaw. All the anterior teeth shut over the lower teeth.

Fig. 13 illustrates a case just the reverse. The upper jaw is normal, but the patient has inherited a larger lower jaw. The teeth shut over the upper teeth.

Fig. 14 illustrates a typical jaw of our native American women. Both jaws are normal. They are slender, and the bodies are large; the rami are very short.

Results of Arrest of Development of the Jaws.

By the accustomed eye arrest of development of the maxillæ is readily detected, both from external as well as internal observations.

In walking along the street, one is struck with the large number of individuals who present the following facial characteristics: The nose is pointed, flattened upon either side, the nasal cavities nearly if not quite closed, owing to the collapsed condition of the outer plate. The superior maxillary bone commences to slope gradually inward from the infraorbital foramen, until a point is reached in a line drawn from the anterior nasal spine to the lower lobe of the ear. This concavity extends backward as far as the malar process. I have frequently observed this peculiar condition among periodical drunkards. To

such an extent does this exist in some cases that it becomes absolutely painful to talk with one thus afflicted, this being the usual expression of one who is suffering extreme pain or who has undergone a long illness. This deformity varies from a slight depression not noticeable to the unaccustomed eye, to the flattened face easily recognized by the tyro. While the facial expressions just mentioned are very common, a yet more noticeable external deformity is one where there is a marked depression at the alæ of the nose. If we will examine critically the faces of an audience in a church, theater, lecture-room, or public conveyance in Chicago, we will observe that from thirty-five to fifty per cent. of all the people present the peculiar facial characteristic mentioned above. Within the last six or eight years I have repeatedly made these observations, with the above-mentioned results. If, then, so large a percentage of arrest of development of the bones of the face is noticed among the citizens of Chicago, which is composed of people of one generation or two from all parts of the globe, how much larger percentage would we expect to find in the older cities of the country, such as those of New England and the Eastern states, where the present people are composed of individuals of the third and fourth generation, who have been subjected to all the discomforts and privations incident to city life for many years, as well as hereditary taint in all of its varieties? As some of the constitutional diseases and deformities are much more common among the people in older cities, we would naturally expect to find deformity or arrest of development of the bones of the face more common also. A closer inspection of the mouth, however, will reveal more marked results of the effects of the arrest of development of the superior maxillæ. If we will examine the skull of one of the pre-historic races or the mouth of one of the pure races, we will observe that the maxillary bones are larger, the teeth and alveolar process stand perpendicularly upon the jaw, and the teeth are perfectly even, as in Fig. 14. On the other hand, if we examine the jaw of an individual who possesses the above-mentioned deformity, we will see that the teeth and alveolar process in many cases seem to protrude. A closer inspection reveals the fact that there is arrest of development of the superior maxillary bone, and that the protrusion is a natural arrangement of the teeth and alveolar process.

In the study of deformities of the jaws with a view of ascertaining the causes of irregularities of the teeth, which I found to be arrest of development of the jaw, I collected three thousand models, and classified them according to their various forms. While there were no two jaws alike, yet the general outline of each group was the same.

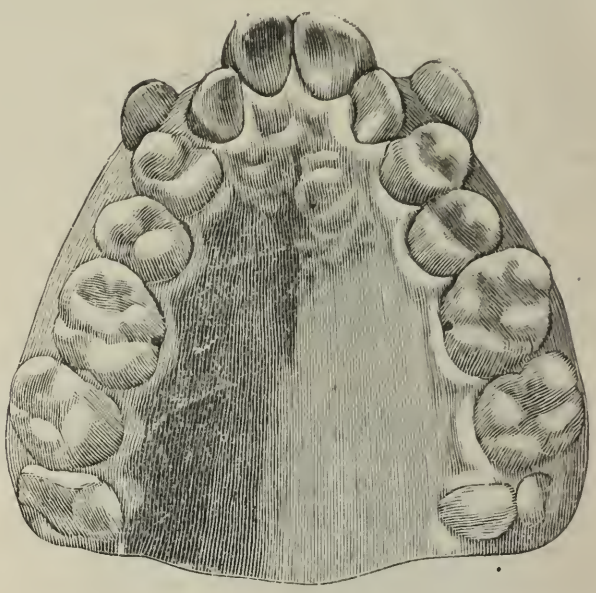
By this plan I have been able to classify all the irregularities of the teeth that are due to constitutional causes or arrest of development of the jaw. These deformities of the teeth and jaw are easily divided into two great classes: first, the V-shaped arch, Fig. 15, where we observe the pinched condition at and anterior to the cuspids; second, the saddle-shaped arch, Fig. 16, where the pinched condition of the jaw is posterior to the cuspids.

In the first variety, the alveolar process and teeth always protrude. In the second class they never protrude.

Other deformities are all modifications of these two varieties. Thus,

in Fig. 17, we see a partial V which is neither a full arch nor a V shape. Fig. 18 shows a partial saddle, where the bicuspids are carried slightly inward. Fig. 19 shows a semi-V, where only one side is carried inward, and Fig. 20 shows a semi-saddle. Fig. 21 illustrates a blending of both varieties, a semi-V and semi-saddle on

FIG. 15.



one side. The variety to be produced depends entirely upon the order of the development of the teeth.

In the discussion of papers read by me in medical and dental societies, the argument has frequently been advanced that out of all

FIG. 16.

of the conditions mentioned in this paper a new race would eventually be evolved, as distinct in form and appearance as any one of the European races.

My answer to these remarks is, "If by these changes normal jaws

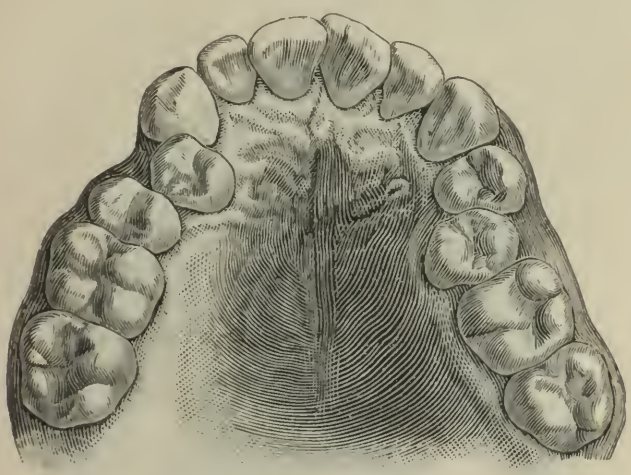
and teeth could be produced, no matter how small the jaw, we might expect a new type would be produced ; but such normal development is out of the question, because, first, owing to the neurotic condition in which we are fast drifting, arrest of and excessive development of the jaws are becoming more common ; and second, the teeth are the

FIG. 17.

same size to-day that they were three thousand years ago. They do not diminish in size in proportion to the jaws, hence irregularities of the teeth will become more numerous."

I cannot do better, in closing this article, than to quote E. Ray Lankester:*

FIG. 18.

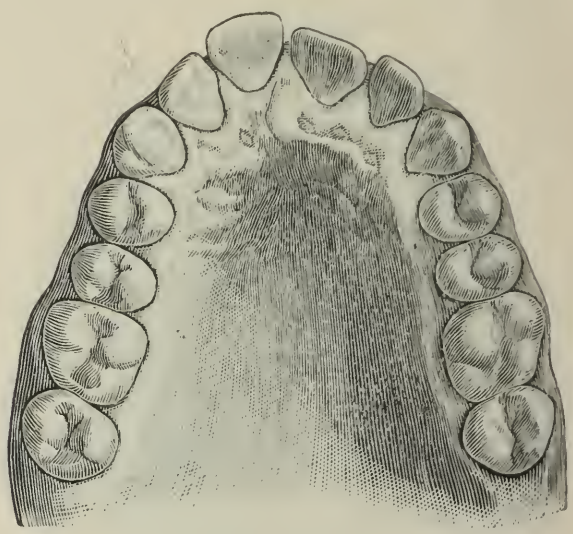


"Degeneration may be defined as a gradual change of the structure in which the organism becomes adapted to less varied and less complex conditions of life ; while elaboration is a gradual change of structure in which the organism becomes adapted to more and more varied and complex conditions of existence. In elaboration there is

* "Degeneration," Humboldt Library.

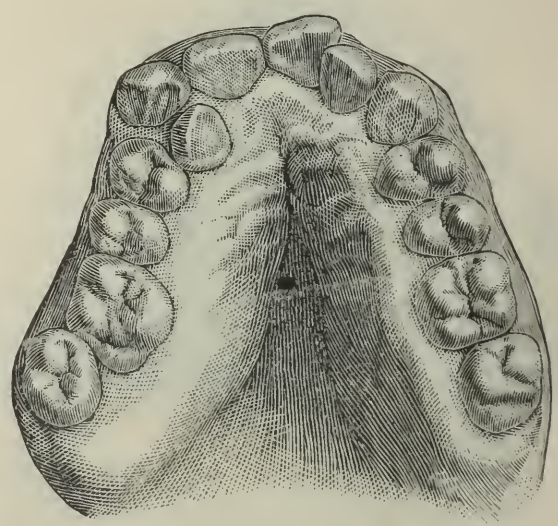
a new expression of form, corresponding to new perfection of work in the animal machine ; in degeneration there is suppression of form, corresponding to the cessation of work. Elaboration of some one organ may be a necessary accompaniment of degeneration in all the others ; in fact, this is very generally the case ; and it is only when

FIG. 19.



the total result of the elaboration of some organs and the degeneration of others is such as to leave the whole animal in a lower condition—that is, fitted to less complex action and reaction in regard to its surroundings than was the ancestral form with which we are comparing it (either actually or in imagination)—that we speak of that animal as an instance of degeneration.

FIG. 20.



"Any new set of conditions occurring to an animal which render its food and safety very easily attained, seem to lead, as a rule, to degeneration ; just as an active, healthy man sometimes degenerates when he becomes suddenly possessed of a fortune, or as Rome

degenerated when possessed of the riches of the ancient world. The habit of parasitism clearly acts upon animal organization in this way.

FIG. 21.

Let the parasitic life once be secured, and away go legs, jaws, eyes, and ears; the active, highly gifted crab, insect, or annelid may become a mere sac, absorbing nourishment and laying eggs."

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